

## Section V. Areas of Concern

As noted in Section 2.02, public meetings were held and surveys were conducted to identify stakeholder concerns. These concerns included:

- Streambank erosion, log-jams and debris, flooding
- Storm sewers, municipal sewer systems
- Dumping, illegal scrap yards
- Acid mine drainage, gob piles, slurry ponds
- Surface soil erosion, farm nutrients, farm herbicides and pesticides, cattle in streams, loss of ag lands
- Chemigation / fertigation, use of surface water in irrigation
- Land-clearing in riparian areas, merging of small farm fields (loss of wind breaks)
- Surface coal operations, construction of oil & gas wells
- Loss of property tax associated with managed lands and lands associated with mining operations
- Recreational value of lands, fishery health, wildlife habitat
- Invasive plant and animal (fish) species
- Gob piles, acid mine drainage
- Methamphetamine labs, anhydrous ammonia thefts / associated leaks
- Lack of funding, economic well-being of the community, poverty levels
- Lack of private septic inspections, day-lighted septic systems
- Lack of ditch easements, county road conditions, lack of road buffers
- Poor drainage class of soils
- Property rights

These concerns were used to identify primary water quality concerns which were typically associated with land uses and practices. Additional areas and practices of concern were identified during the initial monitoring phases of this project. These following concerns occur within the Busseron Creek Watershed and are summarized in alphabetical order.

### 5.01 Abandoned Mine Lands

As noted in Section IIIg, the residual effects of pre-SMCRA and abandoned mine lands have severely impacted surface water quality as a source of acid mine discharge, through topographic and hydrologic changes. These “stressed” areas have also provided a foothold for invasive plant species, further degrading their ecological health.

#### (a) Acid Mine Discharge (AMD)

##### Problem

*AMD enters surface waters, lowering pH levels and raising metals contents, severely diminishing water quality and aquatic habitat.*

##### Discussion

Sulfuric acid is created by oxidation of pyrites through exposure to water or air. The pyrite deposits have either been exposed by mining activities or are contained in deposits placed at or above the water table. As contaminants are diluted with cleaner downstream surface waters, pH rises and metals precipitate out of solution, contaminating stream beds.

##### Support

Indiana Department of Natural Resources – Division of Reclamation data has shown pH levels as low as 2.39 at current test locations throughout the Friar Tuck AML sites. Sites with low pH were also found to have high sulfate concentrations – further confirming the presence of sulfuric acid contamination of surface waters. In addition, those sites showed elevated levels of dissolved aluminum, iron, manganese, and total dissolved solids. See Section 4.02 – Abandoned Mine Lands Benchmark Assessment and Appendix D(a) IDNR – Division of Reclamation data for TMDL sites 7, 8, 12, and 16.

Visual observations of both small and large-scale AML sites often show a lack of vegetative cover and “rusting” of soils and stream beds. Downstream locations are often streaked with rust (Fe) or white (Al) precipitates. See *Figure III-13 – Lands Designated as Abandoned Mine Lands*, page 43 for illustration of documented AML sites.

## (b) Topography and Hydrology Alteration

### Problem

*Historic pre-law practices and early post-law practices have harshly altered surface topography, severely distorting surface water run-off.*

### Discussion

East-central areas of the watershed, commonly associated with AML sites are scarred with a series of ridges that typically drain to land-locked “lakes” created by abandoned mining pits. These lakes are often very deep with steep drop-offs that are not conducive to native aquatic species.

Streams have been redirected and channelized, increasing stream bank erosion and sedimentation. In some areas, headwater streams have been completely eliminated, reducing their “ability to hold and store water which can result in increased frequency and intensity of downstream flooding as well as lower base flows.” (Dunne and Leopold 1978)

Subsidence, or the lowering of the Earth’s surface due to collapse of bedrock and unconsolidated materials into underground mine areas, provides an entry of surface water (or anecdotally – grey water and/or septic effluent). These liquids can contribute to the creation of AMD. They may also pose a concern for groundwater contamination.

### Support

- Documented acreage of AML sites from Division of Reclamation combined with visual observations of hogback / lake complexes.
- GIS documentation of “unnaturally straight” streams in the Mud Creek watershed. (See *Figure IV-4 – Mud Creek-Big Branch Tree Canopy and Habitat Evaluation*, page 77)
- Man-made lake complexes combined with oral history of stream removal (See *Figure IV-7 – Buttermilk Creek Tree Canopy and Habitat Evaluation*, page 80)
- Documented subsidence areas combined with anecdotal evidence of grey-water disbursal. (See *Figure III-15 – Closed Underground Mines*, page 45)

## (c) Problem Statement - Invasive Plant Species

### Problem

*Introduction of invasive species contributes to water quality degradation decline of native habitat.*

### Discussion

The EPA defines an invasive species as:

*“a species whose presence in the environment causes economic or environmental harm or harm to human health. Native species or non-native species may show invasive traits, although this is rare for native species and relatively common for non-native species.”*

Invasive species effects on water resources can be direct, as in the case of Eurasian watermilfoil, or indirect, as in land-based species that change water tables, runoff dynamics, and other conditions that can alter surface water quality.

Aquatic-based invasives like Eurasian watermilfoil (typically associated with recreation - *not* abandoned mine lands) smothers native plants by forming thick, tangled stands of stems underwater and vast mats of vegetation on the surface of the water. Decomposition of mats lower dissolved oxygen levels and accelerated filling of lakes and ponds.

Shallow-rooted terrestrial invasives, such as Japanese knotweed contribute to erosion and stream bank collapse by out-competing deeper-rooted native species.

Species such as Amur bush honeysuckle can almost stop tree regeneration, eliminating the next generation of forest – and critical riparian areas. In addition, their leaf out and leaf drop dates reduce light penetration, thus shading out native grasses and forbs. The resulting bare ground has a higher run-off potential.

Support

- Documented infestations of invasive species, including Eurasian watermilfoil, Amur bush honeysuckle, and Japanese knotweed.
- Information from Invasive species groups and taskforces, including the Midwest Invasive Plant network, The Nature Conservancy, and IN-DNR Invasive Species Task Force, and Southern Indiana Cooperative Weed Management Area.

## 5.02 Active Mineral Extraction

### (a) Surface Coal Mines

Problem

*Reclaimed surface coal mine areas are very susceptible to soil erosion and elevated surface water temperatures.*

Discussion

Although post-Surface Mining Control and Reclamation Act (SMCRA) coal mining operations are required to restore lands to pre-mined condition, the final soil placements are extremely fragile and susceptible to surface erosion.

Re-establishment of healthy subsoil ecosystems that help stabilize soil structure (including root mass, microscopic organisms, annelid and insect populations) can take decades to re-establish. The establishment phase of vegetative/forested stream canopies leaves surface waters more susceptible to extreme temperature variation and stream bank erosion, which result in degraded aquatic habitat.

The settling of disturbed soils directly affects the long-term stability of county roads by exacerbating normal freeze-thaw cycle damages.

Support

- Well-established soil fragility issues documented by the coal mining industry and regulatory agencies.
- On-going county road settling.
- BCWP documentation of surface water temperatures in the West Fork Busseron and Chowning Creek Watersheds combined with GIS overlay of tree cover in areas of active mining (*Figure IV-1 – Chowning Creek Tree Canopy and Habitat Evaluation Figure IV-2 – West Fork Busseron Tree Canopy and Habitat Evaluation*, pages 74-75).

Contributing Factors

- Landowners and tenants may not understand the need to treat post-mined soils as fragile ecosystems.
- Increased maintenance requirements of post-mined county road systems are beyond municipalities' capabilities.

### (b) Oil & Gas Wells

Problem

*New oil and gas well construction damages surface soil structure and pose a threat to vegetation and aquatic life.*

Discussion

Construction of new well sites on reclaimed coal ground severely damages already unstable county roads and surface soils. New well sites have left areas of the county pock-marked with barren pads of crushed limestone and equipment.

Large volumes of water produced in the early stages of well production typically have high saline levels that pose a threat to vegetative and aquatic life if handled improperly. There is anecdotal evidence of past brine spills and fish kills in local waters.

Support

- Anecdotal evidence of brine spills.
- Visual documentation of construction methods.

Contributing Factors

- Construction methods are approved and regulated by Indiana Department of Natural Resources – Oil & Gas Division.
- Mineral rights are typically no longer owned by landowners.
- Sensitive area mitigation sites as required by regulatory permitting procedures may be located outside of the HUC12 or HUC10 watershed area.

## 5.03 Agriculture

As the largest land use in the Busseron Creek Watershed (57%), the impacts of agriculture are widespread. As summarized in Section IIIf, the majority of agriculture production acreage is dedicated to corn-soybean rotations in a conventional tillage system.

### (a) Commodity Crops

#### (i) Soil Erosion

Problem

*Soil erosion resulting from cropping practices contributes heavily to increased sedimentation, turbidity, nutrient and pesticide loads.*

Discussion

Tillage practices, lack of cover crops, and low crop residue (especially following soybean crops) leave production acreage soils exposed and highly susceptible to sheet erosion. Soil migrates through sheet runoff and channeled erosion directly to surface streams or via field tile systems (entering through stand-pipes). In addition, studies have shown that areas lacking residue or cover have lower rates of precipitation absorption and higher rates of surface run-off volume and speed than in areas with high residue content or planted to cover crops during fallow seasons

Encroachment and elimination of riparian buffers adjacent to agricultural fields allows soil to move unimpeded into streams and contributes heavily to stream bank destabilization and collapse. Lack of grassed waterways and filter strips in natural drainage channels promote gully erosion. Even where these practices have been established in the fragile soils of reclaimed mine lands, anecdotal evidence indicates a large percentage are removed by growers/landowners once bonds have been released.

Agriculture-related soil erosion contributes heavily to:

- Sedimentation, resulting in stream bed smothering
- Increased turbidity, resulting in an increase of heat absorption, and a decrease of photosynthetic activity – which combine to reduce dissolved oxygen levels.
- Increased soil-attached phosphorus loads, particularly during the spring season, contributing to algal blooms which decreases light penetration. Decay of algal blooms severely depletes available oxygen.
- Transport of chemicals to surface waters.

Support

- Visual evidence of heavy stream bed sedimentation and smothering during sampling events and CQHEI assessments.

- Impaired / highly impaired Subwatersheds (for sediment) correlate with areas of concentrated agricultural activity (See *Table VI-2 – Parameter-based Critical Watersheds*, page 197 and *Figure III-9 – Cultivated Areas*, page 35)
- Elevated TSS & turbidity during periods of heavy tillage and planting. See Appendix A – BCWP Sampling Data.
- Studies showing elevated N & P levels during spring.

#### Contributing Factors

Contributors to the slow adoption of conservation tillage practices and planting of cover crops include:

- High cost of equipment conversion.
- Skills required, especially in production of no-till corn.
- Studies that have shown possible yield decrease in no-till cropping systems.
- Lack of information about fuel and time reduction, especially in no-till cropping systems.
- Cost and time factors of cover crop establishment.

Contributors to removal of riparian buffers and filter strips include:

- Economic pressures to increase cropped acreage.
- Large pieces of agricultural equipment are difficult to maneuver in areas constricted by multiple filter strips and buffers.
- Mid-field filter strips often result in point rows – areas of higher plant density and lower yields.

## **(ii) Farm Chemicals**

#### Problem

*Farmers of the Busseron Creek Watershed use chemicals which have the potential to enter creeks, possibly degrading water quality.*

#### Discussion

After peaking in the late 1970's pesticide use by U.S. farmers steadily declined through the 1990's and has held steady since that time. Use of genetically-modified crops (GMOs) has been credited with that decline, especially the decrease of insecticide use.

According to a 1996 USDA study, a variety of pesticides were commonly found in streams throughout the White River Basin. Concentrations of individual pesticides were generally greatest in areas where their use was the greatest.

Glyphosate (Round-up<sup>©</sup>), one of the most commonly used farm chemicals, enters surface water through three routes: direct application to aquatic vegetation, binding to soil that washes off treated terrestrial sites, or through drift from treated areas that are near water. This is due to the chemical's tendency to attach to soil particles. Other chemicals that have high adsorption rates, such as Treflan<sup>©</sup> (Trifluralin) or Prowl<sup>©</sup> (Pendimethalin) are likely to be delivered to surface waters in a similar manner.

Other chemicals with low soil adsorption rates and high water solubility, such as Banvel<sup>©</sup> (Dicamba) and Lannate (Methomyl) are more likely to leach through soils and be transported to surface waters through drainage tiles.

Hazards and toxicity levels of these chemicals vary greatly.

#### Support

- Studies by agencies, and universities such as USGS, EPA, Purdue, and University of Illinois.
- According to the USGS publication "Occurrence of Pesticides in the White River", the total amount of herbicides transported by the river is about 1 percent or less.
- Based on 2001 treated acreage and rates from USDA - National Agricultural Statistics Service, and combined with information from the USGS study (1% runoff, above) the following commonly used pesticide loads may be expected in the Busseron Creek Watershed as a result of corn and soybean cultivation:
  - Atrazine – 491 lbs

- Metoachlor, S-Metoachlor – 240 lbs
- Glyphosate (bound to soils) – 496 lbs
- Acetochlor – 183 lbs
- 2-4, D – 50 lbs
- Note: Due to cost constraints, the presence of commonly used farm chemicals were not included as part of the water quality testing parameters.

#### Contributing Factors

- Lack of market opportunities severely inhibit the addition of crops in a rotation. Those additional crops would help break pest cycles.
- Adoption of precision agriculture technology such as swath control and variable rate application to reduce application rates and overlap can be extremely expensive – especially for small to medium sized operations.

### **(iii) Fertility Programs**

#### Problem

*Surface water concentrations of phosphorus and nitrogen exceed State standards in areas of heavy agricultural activity.*

#### Discussion

Soybean rotations reduce the amount of nitrogen applications required for the following corn crops. However, corn is a “heavy feeder”, requiring high amounts of available nutrients to produce viable yields.

- Late fall applications of nitrogen as anhydrous ammonia (NH<sub>3</sub>) are susceptible to nitrification (conversion to NO<sub>3</sub>) during warm, wet weather, including the following spring. The resulting nitrates are more easily moved through the soil, and enter surface waters through field tile systems.
- Spring applications of nitrogen, including starter fertilizer and side dress of applications are also susceptible to denitrification losses during periods of warm, wet weather.
- Phosphates are typically applied during winter months while soils are frozen. They tend to attach to soil particles and are more typically lost through surface run-off and resulting soil erosion.
- Most nitrogen and phosphate loads from agricultural practices will occur during spring seasons.

In addition, theft of anhydrous ammonia for the production of methamphetamine is a well-known and documented hazard for rural communities, including the Busseron Creek Watershed.

#### Support

Under normal spring conditions, sampling should show higher levels of phosphorus from surface run-off and nitrogen from tile systems. However, 2009 planting delays caused by cool, wet weather resulted in a conversion from the longer-season, high-nutrient consuming corn crops to the shorter-seasoned, lower nutrient-consuming soybean crops. Expected levels of nutrient loads were calculated using proven models (STEP-L and Center for Watershed Protection Watershed Treatment models). See *Table VI-3 – Loads and Suggested Reductions*, page 226.

#### Contributing Factors

Factors influencing fertility programs include:

- Reduced yields due to nutrient deficiencies
- Lodging caused by nutrient imbalances or deficiencies can reduce yields by 25%
- Plants stressed by nutrient deficiencies are more susceptible to plant and disease infestation

### **(iv) Irrigation**

#### Problem

*Irrigation systems can contribute to high levels of surface run-off and associated soil erosion.*

#### Discussion

Center-pivot irrigation systems, such as those found in the Western regions of the Busseron Creek Watershed are typically sited on light, sandy soils that are susceptible to soil erosion. These irrigated

fields are typically managed to produce high yielding commodity crops or high-value crops such as seed corn, seed wheat, green bean, tomato, or melon crops. Very few, if any of the tracts are no-tilled.

The force of irrigation droplets hitting the ground breaks down surface soil structure, forming a thin compacted layer that greatly reduces water infiltration. Soil surface sealing continues to develop with each additional irrigation. In addition, high application rates, especially on the outer pivot sections, exceed the infiltration rate of most soils.

These conditions combine to increase surface run-off and surface soil erosion on irrigated fields.

#### Support

- Studies by USDA, University of Idaho, University of Michigan, Purdue.
- Visual evidence of erosion in irrigated fields – Rogers Ditch and Tanyard Branch Subwatersheds.

#### Contributing Factors

- Increased production of specialty crops in area.
- 30% increase in irrigated acres from 2002 – 2007.
- Seed crop contracts typically require intensive tillage practices.

### (v) Lack of Riparian Buffer Zones

#### Problem

*Encroachment of agricultural fields into riparian buffer zones have severely diminished natural cooling and filtering systems.*

#### Discussion

Sediment and sediment-associated pollutants, such as phosphorus, bacteria, and some pesticides move to surface waters by surface run-off. Riparian buffer zones can effectively slow surface water movement, allowing sediment to settle out before reaching streams and creeks.

Nitrogen from agricultural fields typically moves as nitrates through groundwater. To remove nitrate from groundwater before it reaches surface water, the groundwater must enter a zone where plant roots are or have been active. Riparian forest buffers reduce nitrogen under most conditions. (Studies have shown 18 – 55 pounds of nitrogen per acre per year)

Shade provided by vegetation during summer months maintains cooler, more even temperature, especially on smaller streams. Cooler water holds more oxygen and reduces stress on fish and other aquatic organisms. A few degrees temperature can have a major effect on their survival.

#### Support

- Various studies demonstrating the positive impact of forest buffer zones in reducing the influence of agricultural nutrients and chemicals on surface stream waters.
- Elevated temperature, turbidity, and loads of nutrients downstream from areas devoid or nearly devoid of riparian buffer zones in the Busseron Creek Watershed.
- Note lack of tree cover upstream from temperature-impaired BCWP sites 14, 15, and 16: *Figure IV-1 – Chowning Creek Tree Canopy and Habitat Evaluation and Figure IV-2 – West Fork Busseron Tree Canopy and Habitat Evaluation*, pages 74-75.

#### Contributing Factors

Contributors to removal of riparian buffers and filter strips include:

- Economic pressures to increase cropped acreage.
- Wooded buffers, reduce soil-available moisture and shade crops, resulting in reduced yields in areas 30-50 feet from tree lines.
- Large pieces of agricultural equipment are difficult to maneuver in areas constricted by multiple filter strips and buffers.
- Mid-field filter strips often result in point rows – areas of higher plant density and lower yields.

- Damage of expensive agriculture equipment by overhanging branches and downed trees/tree limbs in areas adjacent to wooded buffers.

## (b) Livestock

Confined livestock operations are a minimal concern in the Busseron Creek Watershed. Water quality concerns for these and other livestock operations revolve around manure applications and unrestricted stream access.

### (i) Manure Applications

#### Problem

*Winter applications of manure can contribute to nutrient loading of surface waters.*

#### Discussion

Manure applications in the area are mostly of turkey litter and are typically made during winter months while ground is frozen to limit wheel ruts. This also coincides with a season in which run-off is more likely – frozen soils can be nearly as impervious as parking lots.

- Studies in Vermont, Minnesota, and Iowa recorded losses of 20-30% of applied nitrogen and phosphorus from winter-applied manure.
- Winter application of manure can result in runoff concentrations of nitrogen and phosphorus from two to 15 times higher than those from summer applications.
- In winter, when manure rests on the soil surface, interaction with soil is minimal and manure organisms are more readily carried away in run-off.
- Cool temperatures and moist conditions in winter favor longer survival of microorganisms on the land. In warm weather, most manure pathogens are killed or immobilized in soils by physical filtration, adsorption or predation by native soil microorganisms.

#### Support

Visual observation of winter-applied turkey litter, especially in the Rogers Ditch, Tanyard Branch, and Middle Fork Subwatersheds.

#### Contributing Factors

Contributors of winter applications of manure include:

- Seasonal nature of agriculture – with exception of winter wheat, manure is not spread in fields with growing crops.
- Concerns about soil compaction and/or rutting during warmer, wetter months.

### (ii) Pasture Management

#### Problem

*Poor pasture management contributes to increased run-off of nutrients, E. coli, and erosion.*

#### Discussion

Overgrazed pastures result in compacted soils and degradation of vegetative cover. The compacted soils are unable to absorb precipitation and the resulting run-off flow to streams is relatively unimpeded by surface vegetation.

- Surface run-off can carry high levels of E. coli and nutrients into streams and creeks.
- Overgrazed areas lack appropriate vegetative cover to control soil erosion or filter surface run-off.
- Small pastures often effectively become dry lots which lack filter strips. Waste and surface soils wash into surface creeks and streams.
- Livestock prefer new plant growth and re-graze portions of pastures repeatedly until the area is near barren.

#### Support

Visual observations of overgrazed lots, especially for small acreage hobby-farms or recreation animals.

#### Contributing Factors

- Lack of education on pasture acreage required for animals, particularly those kept for recreation purposes.

### **(iii) Unlimited Stream Access**

#### Problem

*Unrestricted stream access by domestic animals such as horses, cattle, and goats destabilizes stream banks.*

#### Discussion

Uncontrolled livestock access to streams can result in bank erosion, damage streamside vegetation and degrade water quality with solid waste pollution.

- Midstream “loafing” during hot weather churns stream beds and contribute to solid waste loads.
- Common access points are heavily compacted by livestock traffic and devoid of surface vegetation.
- Collapse of stream banks (gully-ing) in historically grazed areas are common.

#### Support

Visual observations of stream bank destabilization and compaction of heavy use areas.

#### Contributing Factors

- Large deer populations also contribute to stream bank erosion
- Fencing out livestock can be cost-prohibitive
- Cost to replace streams and creeks as a source of water to livestock.

## **5.04 Logging / Land Clearing**

#### Problem

*Poorly planned and conducted logging or land clearing activities contribute to stream bank destabilization, stream turbidity, and elevated water temperatures.*

#### Discussion

Some logging operations within the watershed are conducted without implementation of best management practices or logging plans. They leave surface soils rutted and compacted. They also remove mast-bearing trees, eliminating wildlife feed and seed for re-growth. The long-term health of forested areas is reduced because smaller trees are not allowed to fully mature and deeply harvested areas are not replanted.

Land clearing close to surface waters, including ephemeral streams leads to stream bank erosion or collapse and increased turbidity of downstream waters. As noted in the agricultural section, riparian buffer zones can effectively slow surface water movement, allowing sediment to settle out before reaching streams and creeks. In addition surface water that is no longer slowed by riparian vegetation, contributes to flooding episodes, increased erosion by fast-moving water, and channelization of streams.

Shade provided by vegetation during summer months maintains cooler, more even temperature, especially on smaller streams. Cooler water holds more oxygen and reduces stress on fish and other aquatic organisms. As a few degrees temperature can have a major effect on their survival, removal of stream-side forested canopies can severely impact surface water health.

#### Support

- Visual evidence of heavy stream bed sedimentation and smothering downstream from cleared lands.
- Elevated stream temperatures and turbidity documented by BCWP in areas downstream from cleared lands.

#### Contributing Factors

- Landowners view sales of standing timber to sales of mineral rights, but are less educated about what shape their land will be left in.
- Landowners are often unprepared or unequipped to replant and/or restore post-timbered lands.
- Note lack of tree cover upstream from temperature-impaired BCWP sites 14, 15, and 16: *Figure IV-1 – Chowning Creek Tree Canopy and Habitat Evaluation* and *Figure IV-2 – West Fork Busseron Tree Canopy and Habitat Evaluation*, pages 74-75.

## **5.05 Lawn / Landscaping**

#### Problem

*Lawn and/or landscaping chemicals and fertilizers can enter streams and creeks through surface run-off*

#### Discussion

A quest for the perfect lawn or landscape often results in applications of chemicals as a matter of course, rather than need. The consequences of these treatments can include:

- An over-application of fertilizers which enter streams through surface run-off.
- Broadcast of chemicals onto impervious areas such as sidewalks and driveways. If these chemicals are not swept and disposed of properly, they can wash into surface drainage systems – and into surface streams.
- Lack of riparian buffers on urban creeks. Although turf does absorb some precipitation, manicured lawns do not sufficiently slow run-off to filter contaminants.
- Maintenance of area golf course and parks follows a similar pattern to residential care: applications of fertilizers and chemicals as a matter of course and lack of riparian buffers.
- In addition to contamination of streams and creeks, highly-maintained lawns lack diversity of plant life required for beneficial insects.

#### Support

- Visual documentation and anecdotal evidence of typical residential lawn and landscaping care.
- SCPL and Elks Country Club golf course maintenance practices.
- Elevated phosphorus loads downstream from residential areas (BCWP sites 7 & 8)

#### Contributing Factors

- Perception of a neatly maintained lawn as one species of lush green grass.

## **5.06 Municipal Infrastructure**

### **(a) Impervious Surfaces**

#### Problem

*Imperviousness of parking lots, roofs, streets, and sidewalks does not allow absorption of rain or melting snow, increasing run-off which results in negative impacts on surface water and habitat quality.*

#### Discussion

Structures and paving prohibit absorption of rain or melting snow. A 1,000 square foot area of roof, parking lot, or street will produce 623 gallons of run-off in a 1-inch rain. Even lawns, sloped to encourage run-off, do not rapidly absorb precipitation.

From an Ohio State University Fact Sheet:

*In many places, as little as 10% impervious cover has been linked to stream impacts, which increases in severity as impervious cover increases (Schueler, 1995). The amount of impervious cover in the watershed can be used as an indicator to predict how severe these impacts might be. Research has shown that as the amount of impervious surface increases, the amount of runoff generated increases. This leads to increased amounts of water flowing in the stream, especially during heavy rainfalls; less ground water flowing through the soil (base flow); and more erosion of the stream bed because of faster*

*flowing water. These changes to stream flow result in flooding; habitat loss; erosion, which widens the stream channel; and physical changes in how the stream looks and functions.*

**Impacts from Increases in Impervious Surface Coverage (USEPA, 1997).**

Increased Imperviousness Leads to:	Resulting Impacts					Stream Alteration
	Flooding	Habitat Loss	Erosion	Channel Widening		
• Increased Amount of Flow	X	X	X	X	X	X
• Increased Peak Flow	X	X	X	X	X	X
• Increased Peak Duration	X	X	X	X	X	X
• Decreased Base Flow		X				
• Sediment Loading	X	X	X	X	X	X

*The effects of urbanization on riparian habitat, and macroinvertebrate and fish communities can generally be classified into three categories: low, moderate, and high (USEPA, 1993). At low levels of urban development, the riparian zone has lots of vegetation and no erosion from the stream banks; there are lots of different species of fish and macroinvertebrates in the stream. At moderate levels of urban development, some of the riparian plants have been removed and there is some erosion of the stream banks; there is less of a variety of macroinvertebrate and fish species in the stream. At high levels of urban development, the riparian area is nearly gone and the stream banks are completely bare, which increases erosion of the stream banks; there are just a few different species of fish and macroinvertebrates in the stream because habitats within the stream were destroyed and the pollution intolerant species have either left or died.*

Support

- Visual documentation
- Habitat assessments of streams, in particular BCWP Site 8.

## (b) Road and Ditch Maintenance

Problem

*Gravel roads and ditches are often severely degraded, contributing to impaired surface water run-off and stream sedimentation.*

Discussion

Unpaved roads are considered to be the largest source of particulate air pollution in the country. According to the Environmental Protection Agency, unpaved roads produce almost five times as much particulate matter as construction activities and wind erosion (the next two largest sources) combined. Dust coats roadside vegetation and structures from where it can be washed by rains and into ditches and streams as surface run-off.

When the smaller components of paving materials (road fines) are lost as dust, it deteriorates the gravel surface. Larger aggregate pieces become exposed and are then scattered by vehicles or washed away. In many areas

of the watershed, pit-run gravel is typically used for surfacing. The rounded shape of the material is easily displaced rather than compacted into a more durable road bed. The unstable road becomes rough, developing potholes and washboarding. These damages hold water which then infiltrate and damage the road base. In addition, the eroded material damages ditches and drainage systems.

These issues are compounded by grading activities that remove crowns and sometimes add washboarding. The grading often does not extend to shoulders, resulting in a drop from the shoulder to the road – surface road water cannot reach ditches and flows down the road, further damaging the road surface and base.

In areas of prior surface mining, roads are inherently unstable due to settling – again, further compounding damages.

Ditches are not only heavily sedimented by fines from damaged roads, but also from agricultural practices which encroach upon easements. Filter strips that may have existed in easements are no longer present and surface soil erosion freely enters the ditch system. In areas of steep roadside to field slopes, easement encroachment contributes significantly to ditch bank collapse.

Current ditch sediment removal methods leave steep, bare banks that are more susceptible to erosion. Road shoulders may not be graded to improve drainage into ditches.

#### Support

- Visual documentation.
- Known contributors to gravel road degradation.
- Known fragility of reclaimed surface mine ground.

#### Contributing Factors

- Lack of tax base – and municipal funds.
- Lack of training for county employees.
- A joy of “mudding” on county roads.

## (c) Sanitary Sewer Systems

#### Problem

*Combined Sanitary and Storm Sewer systems in urban areas cannot handle current population densities, and release pollutants, including E. coli, chlorine, and suspended solids into surface waters.*

#### Discussion

In urban areas within the watershed, storm water run-off from roofs, parking lots, and streets empties into the same system that carries household wastewater to sewage treatment plants.

These sewer systems were typically built before the mid-20<sup>th</sup> century and disposed of household wastewater by simply discharging it into rivers and streams. Because of concern for water quality and public health, cities built sewage treatment plants to treat wastewater before discharging it. New sewer lines were constructed to carry household wastewater to these treatment plants and diversion dams were built in old sewer lines to divert sewage into the new system and prevent it from discharging directly into streams... except during rain.

The old outfalls were left in place to act as “relief valves” to prevent sewage from backing up into homes during storms. Rain events increase the volume of water in the system, which then overtops the diversion dams, allowing raw sewage to flow into surface streams.

In addition, old sewage treatment plants are over-taxed, resulting in release of pollutants into surface streams. As noted in *Table IV-1 NPDES Permit Violations*, page 87, these older WWTPs have experienced exceedingly large numbers of violations. Point-source concerns in the areas near Sullivan, Dugger, Carlisle, Hymera, Farmersburg, and Shelburn should be noted.

#### Support

- NPDES violations for dissolved oxygen, biochemical oxygen demand, E. coli, total suspended solids, residual chlorine, and ammonia. (See *Table IV-1 NPDES Permit Violations*, page 87)
- BCWP sampling which indicated high levels of E. coli, low dissolved oxygen, and high suspended solids levels downstream from the town of Sullivan. (BCWP Site #8)

#### Contributing Factors

- Money – although municipalities have agreements with IDEM to correct sanitary sewer discharge, all are struggling to find funds for engineering and construction.
- Time – Agreements with IDEM to correct CSOs extend for decades.

### **(d) Stormwater Systems**

#### Problem

*Municipal stormwater systems cannot handle the amounts of surface run-off, resulting in flooding during heavy rain events and subsequent negative impacts on surface water and habitat quality.*

#### Discussion

Imperviousness of parking lots, roofs, streets, sidewalks does not allow absorption of rain or melting snow. Even lawns, sloped to encourage run-off, do not rapidly absorb precipitation.

Stormwater systems in the watershed are not equipped to handle current volumes – streets, homes, and houses have been subject to minor flooding during 1-2" rain events. Removal of riparian corridors and wetlands contributes to water quality degradation because water that reaches surface streams through ditches and sewers is no longer slowed nor filtered by those ecosystems.

- Stream velocities are substantially amplified, increasing stream bank erosion and channelization.
- Pollutants, including road salts, oils, and chemicals are carried by run-off to streams
- Stream bank erosion and channelization contribute to turbidity and total suspended solids levels.

#### Support

- Visual documentation
- Flood-related costs incurred by municipalities.
- Storm event sampling shows increased turbidity and levels of total suspended solids. See Appendix A – BCWP Sample Data.

## **5.07 Private Waste Disposal**

### **(a) Dumping of Refuse**

#### Problem

*Illegal dumping along roadsides and directly into waterways creates biological, environmental, and safety hazards.*

#### Discussion

Household waste and animal carcasses thrown over bridges or into roadside ditches present biological hazards from decaying materials and associated rodent populations. Refuse thrown into creeks foul water supplies for wildlife.

Household chemicals and components in appliances or computers may be a source of toxic wastes. In addition, discarded methamphetamine labs are considered to be hazardous waste sites.

Dump sites become safety hazards for landowners, tenants, and others utilizing the land or cleaning up the site. Costs associated with illegal dumping are two-fold:

- Costs associated with clean-up
- Loss of property value

#### Support

Visual documentation.

#### Contributing Factors

- A common local view that mined property is wasteland owned by rich companies that have/are raping the land without recourse – and dumping of refuse is fair game.
- The practice of dumping in ditches, off bridges, etc. is cultural based: *a practice learned from parents.*
- The cost of garbage removal is either too much for poverty-stricken residents or seen as an unnecessary expense.

## (b) Private Septic Systems

#### Problem

*Raw waste emitted from failing, improperly maintained, or improperly installed private septic systems enters surface waters resulting in excessive nutrient loads and E. coli content that far exceeds State standards.*

#### Discussion

E. coli levels exceeded the 235 MPN State of Indiana standards for recreation activity at all BCWP testing sites. Levels at some sites were over 2,400 MPN.

The overall condition of surface waters are severely degraded by septic pollution. High levels of E. coli not only make waters unsafe for wading, but can make creeks toxic to livestock and wildlife as water sources. High nutrient loads contribute to algal blooms and resulting low dissolved oxygen levels. Embeddedness resulting from deposition of solid wastes destroys habitat.

Thirty-five percent of all dwellings lie outside towns serviced with municipal septic systems. Ninety percent of those structures are over 20 years old. Private septic systems over the age of 20 years can generally be considered to be in a failing condition due to lack of maintenance. Improper installations exacerbate this problem. Some systems discharge into surface waters – and some homes “straight pipe” effluent through farm field tiles or into ditches and streams. In addition, there is much anecdotal evidence of private septic systems draining to areas of subsidence – voids left by collapse of underground mine structures. In fact, in the 1930’s, a sewage system (since closed) was installed in Shakamak Park by “drilling a well-like hole 200 feet down to connect with the old workings of an abandoned mine.”

Further compounding the issue is a high occurrence of swelling clays in the watershed. Complete saturation occurs early in swelling clays, closing pore space and minimizing penetration. Traditional septic systems are not meant to be used in these soil types – yet few alternative septic methods (mound, composting, incinerating, etc) are utilized.

New septic systems are rarely inspected and often fall below accepted standards for new construction: allowing “trickle” pipes to emit grey and black water into streams. There is anecdotal evidence of installation of “straight pipe” systems, often routed through agricultural drainage tile systems.

#### Support

- Results of E. coli testing by BCWP indicate 75% of all test sites (71% of rural sites) exceed State of Indiana standards for recreation.
- Documented odor of raw human waste at multiple test sites.

#### Contributing Factors

- New septic systems are rarely, if ever, inspected by Health Department officials.
- New homeowners are often unaware of acceptable standards – or if their systems meet those standards.
- Over 90% of houses are over 20 years old. The majority of those on private septic have never performed septic maintenance.
- Poverty levels prohibit household expenditures on septic maintenance or repair.

### (c) Unlicensed Scrap Yards

#### Problem

*Collections of vehicles and refuse on private property can be a source of surface soil and water contaminants and lower surrounding property values.*

#### Discussion

Unlicensed scrap yards on private property are not inspected by IDEM or other regulatory agencies. Vehicles are typically not drained of fluids. Fuel, oil, antifreeze and other liquids/lubricants contaminate surface soils and may enter creeks and streams through surface run-off.

Visual impact of multiple, unfenced, and unscreened yards devalues nearby properties.

#### Support

Visual documentation. Repeated legal judgments against individuals.

#### Contributing Factors

“This is my land and I can do anything I want with it.”

## 5.08 Other

In addition to the concerns listed above, some water quality issues have been recognized, but an associated source or practice has not been identified as of this writing.

### (a) Metals Levels in Non-mining Areas

High levels of Aluminum and Iron have been found in areas in the watershed where neither high numbers of mine sites nor widespread mining has been known to exist. Source theories include:

- Soil losses from agricultural areas which have a naturally high metals content.
- The presence of undocumented AML sites with concentrated drainage into surface waters.

## 5.09 Summary – Areas of Concern

Each of the Areas of Concern outlined in this section leaves a “fingerprint” on surface water quality. Just as a doctor uses symptoms to identify a disease, water quality impairments can be used to identify an area of concern. *Table V-1 – Parameters Associated with Concerns* provides a key between the Areas of Concern identified in this section and their associated impairments (parameters).

For example, areas impacted by acid mine drainage are likely to exhibit poor habitat quality. Macroinvertebrates are fewer in number, less diverse and higher tolerance of pollutants than those found in healthy streams. Close to the source, pH will be low. Metal concentrations and total dissolved solids are typically high.

**Table V-1 – Parameters Associated with Concerns**

Concern	Parameter																	
	Habitat Quality	Macroinvertebrates	Impaired Biotic Communities	Temperature	Dissolved Oxygen	pH	Turbidity	Total Suspended Solids	Total Dissolved Solids	E. Coli	Nitrogen, as NH3	Nitrogen, as NO2-NO3	Total Phosphorus	Aluminum	Iron	Copper	Manganese	Large-molecule chemicals
<b>Abandoned Mine Lands</b>																		
Acid Mine Drainage	●	●	●			●		●					●	●	●	●		
Altered Topography and Hydrology	●																●	
Invasive Plant Species	●																	
<b>Active Mineral Extraction</b>																		
Coal Mines	●		●	●			●	●										
Oil & Gas Wells	●	●					●	●										
<b>Agriculture - Commodity Crop Production</b>														●	●			
Soil Erosion	●	●	●	●	●	●	●	●	●									
Farm Chemicals	●	●	●													●		
Fertility Programs	●	●	●	●	●	●		●		●	●	●	●					
Lack of Riparian Buffer Zones	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●		
<b>Agriculture - Livestock</b>																		
Manure Applications	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pasture Management	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			
Unlimited Stream Access	●	●	●				●	●		●	●							
Logging / Land Clearing	●	●	●	●	●	●	●	●	●					●				
Lawn / Landscaping	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
<b>Municipal Infrastructure</b>																		
Impervious Surfaces	●	●	●	●	●												●	
Road & Ditch Maintenance	●	●	●	●	●	●	●	●	●	●	●		●				●	
Sanitary Sewer Systems	●	●	●	●	●	●	●	●	●	●	●	●	●	●				
Stormwater Systems	●	●	●							●	●							●
<b>Private Waste Disposal</b>																		
Dumping of Refuse	●			●													●	
Private Septic Systems	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			
Unlicensed Scap Yards	●			●													●	
<b>Metals in Non-Mining Areas</b>	●	●	●						●				●	●	●	●	●	

## **Section VI. Critical Areas Identification and Prioritization**

### **6.01 Methodology**

#### **(a) Source Identification by Land Use**

As described in Section III, the Busseron Creek Watershed consists of diverse land uses and landscapes that have been significantly altered from their native states – even in “natural” public lands. These land uses and landscape alterations may exacerbate naturally high volumes of surface water runoff and soil erosion resulting from soils with slow infiltration rates and extensive areas of the highly-erodible Cincinnati-Ava soil associations. Likewise, alterations affecting natural drainage may intensify very low seasonal base flows.

In addition to these common concerns, each land use leaves a “fingerprint” on surface water quality. These fingerprints – or source concerns – are further discussed in *Section V - Areas of Concern*. As noted in Section 5.09 and summarized in Table V-1, Areas of Concern and their associated impairments can be used to identify sources of non-point pollution.

## (b) Primary Sources Within Subwatersheds

Habitat quality assessments, windshield surveys, and analysis of geo-referenced land use maps were utilized to identify concentrated land uses within HUC 12 subwatersheds. Primary sources were identified for each HUC 12 watershed and summarized in *Table VI-1 – Sources Associated with 12-digit Subwatersheds*. It should be noted that the habitat quality assessment methodology (Hoosier Riverwatch) and windshield surveys are subjective in nature. Therefore, generalized priority rankings were assessed based upon density of each land use classification. A ranking of “1” indicates a land use (concern) that is considered a highly critical source of non-point source pollution. A ranking of “2” indicates a land use (concern) that is a critical source of non-point source pollution. A ranking of “3” indicates a land use (concern) that is a possible source of non-point source pollution, but not considered to be critical.

Identification of critical land uses by subwatershed will assist in targeting of BMP implementation: agricultural BMPs in areas of concentrated crop and livestock production, urban BMPs in areas of concentrated development, etc.

### (i) Abandoned Mine Lands

#### 1) Acid Mine Drainage

Assuming that all abandoned mine land (AML) sites have the potential for acid mine discharge (AMD), all Subwatersheds containing AML sites received a minimum ranking of “3”. Data from the Benchmark Assessments, in particular data from the Division of Reclamation, was used to further categorize areas of severe AMD. Because of extremely high metal contents and extremely low pH, the Mud Creek and Sulfur Creek subwatersheds were given a ranking of “1”. Because of the extensive acreage of designated AML sites, the Buttermilk Creek subwatershed was given a ranking of “2”.

#### 2) Topography and Hydrology Alterations

GIS analysis of hydrology showed extensive alterations in the Mud Creek and Buttermilk Creek Subwatersheds. Windshield surveys and Division of Reclamation information confirmed these alterations were mining-related. These Subwatersheds were given a ranking of “1”. During the windshield survey, it was noted that the western portions of Middle Fork Creek had also been highly altered – that subwatershed was given a ranking of “2”. Extensive topography changes (ridges and lake systems) throughout the Headwaters Big Branch Subwatersheds led to a ranking of “1” for that subwatershed. Windshield surveys indicated less extensive topography changes in the Sulfur Creek subwatershed, leading to a ranking of “2” for that area.

#### 3) Invasive Plant Species

Invasive plant species have been found in every subwatershed of the Busseron. All Subwatersheds were given a minimum ranking of “3”. Because of extensive infestations throughout the forests and streams of the Buttermilk, Mud Creek, and Headwaters Big Branch Subwatersheds, these areas were given a ranking of “1”

### (ii) Active Mineral Extraction

#### 1) Active Coal Mines

Current surface mining operations and extensive tracts of reclaimed farm ground in the Chowning and West Fork Busseron Subwatersheds led to a ranking of “1” in those areas. Smaller surface mining operations in the Sulfur Creek subwatershed led to a ranking of “2”. Expected start-up of surface mining operations in the Buttermilk and Middle Fork Creek Subwatersheds led to a ranking of “2” in those areas.

#### 2) Oil & Gas Wells

Because oil and gas well concerns were based upon construction and installation, and because geo-referenced permit data has not been made available, windshield surveys were the primary source of ranking. Most construction is occurring in the Tanyard Branch and Middle Fork Creek Subwatersheds,

giving those areas a ranking of “1”. Newer wells for which soils are nearly stabilized are found mostly in an area of western Mud Creek and north-central Buttermilk Creek, giving those Subwatersheds a ranking of “2”. Pipeline construction in the Rogers Ditch and Buck Creek Subwatersheds give those areas a ranking of “2”.

**(iii) Agriculture**

**1) Crop Production**

Ag-related Soil Erosion, Farm Chemicals, Agricultural Fertility Programs, and Ag-related Loss of Riparian Buffer Zones are concerns associated with crop production. Land cover was analyzed to determine percentage of each subwatershed designated as a “Crop Production” land use and ranking was assigned based upon that percentage.

Priority Level 1: >70%

Priority Level 2: 40% - 68%

Priority Level 3: <40%

These rankings were compared to density of crop production (See *Figure III-8 – Farmland Classification*) to substantiate accuracy. This information was then ground-truthed through windshield surveys.

**2) Livestock**

Manure applications are not common in the watershed. Therefore, those Subwatersheds known to have received manure (turkey litter) applications in 2008 – 2009 have been given a priority ranking of “3”

Rankings for Pasture Management and Unlimited Stream Access by Livestock were based primarily upon windshield surveys. Geo-referenced land use maps showed Kettle Creek, Buttermilk Creek, and Morrison Creek Subwatersheds to contain over 10% pasture/hay lands. However, windshield surveys showed Buttermilk pasturelands to have little stream access and Morrison pasturelands were largely unused. Therefore, they were given rankings of “3”. Only Kettle Creek contained populations of livestock (cattle) with ready access to streams – therefore receiving a ranking of “1”. Windshield surveys showed overpastured areas in Chowning Creek and West Fork Busseron - Because the overpastured areas did not appear to have a large impact on stream quality, these subwatersheds were given a ranking of “3”. Pastures in both the Buck Creek and Tanyard Branch Subwatersheds provided unlimited access to streams which showed evidence of long-term livestock-related streambank erosion, but because small pasture acreage and relatively small livestock populations, these subwatershed were given a ranking of “2”

**(iv) Logging / Land Clearing**

GIS analysis of tree canopy revealed that only the Headwaters Big Branch, and Sulfur Creek Subwatersheds had 75% tree canopy on one-quarter of their streams. All Subwatersheds were given a minimum ranking of “3”. Although active surface mining operations are regulated (See Section 3.01(h) *Active Mines*), residual effects on temperature and habitat quality led to a ranking of “2” in the Chowning and West Fork Subwatersheds. Windshield surveys revealed active and destructive land clearing activities in the Headwaters Big Branch and Sulfur Creek Subwatersheds leading to a ranking of “1” for those areas.

**(v) Lawn / Landscaping**

Because of the rural nature of the Busseron Creek Watershed, impacts of lawn and landscaping are not considered to be highly critical, but as region-wide development continues, it is a concern. All Subwatersheds were given a minimum ranking of “3”. Watersheds receiving runoff from towns were given a ranking of “2”

**(vi) Municipal Infrastructure**

**1) Road & Ditch Maintenance**

Because the city of Sullivan and its urban areas lie within the Morrison and Buck Creek watersheds, those areas have a lower concentration of gravel roads. However, windshield surveys showed problems with ditch sedimentation in the Morrison Creek subwatershed – that area received a ranking of “3”. The

remaining Subwatersheds are rural in nature with 43-75 miles of gravel roads each. Because windshield surveys indicated chronic degradation of roads and ditches in those areas, each subwatershed received a minimum ranking of “2”. Remote regions of Chowning, West Fork, Mud Creek, and Buttermilk Creek Subwatersheds (predominantly reclaimed mine lands) were severely degraded, leading to a ranking of “1” in those areas.

**2) Municipal Sanitary Sewer Systems**

Because of their high number of NPDES violations, receiving streams for the Dugger, Farmersburg, and Hymera WWTPs were ranked as “1”. In addition, because of CSO’s located on Buck Creek, this watershed was also given a ranking of “1”.

**3) Stormwater Management**

Surveys of areas downstream from incorporated areas revealed severe channelization and streambank erosion downstream from Sullivan, Shelburn, and Hymera. Visual evidence of bankfull conditions immediately following rain events provides supporting evidence that runoff from these towns are a leading cause of stream erosion in these areas. Because of this, Sulfur Creek, Kettle Creek, Morrison Creek, and Buck Creek were assigned rankings of “1”.

**(vii) Private Waste Disposal**

**1) Dumping of Refuse**

Windshield surveys during sampling events indicated chronic illegal dumping in remote areas of the watershed. The most highly impacted areas appeared to be located in the reclaimed mine lands of Mud Creek and Buttermilk Creek. Those Subwatersheds were given a ranking of “1”. Remote areas of West Fork Busseron, Chowning Creek, Kettle Creek, and Middle Fork Creek were also regularly impacted, but to a lesser extent – therefore those areas were awarded a ranking of “2”

**2) Private Septic Systems**

Because

- 75% of all BCWP test sites exceeded Indiana standards for E. coli;
  - 90% of residential structures are over 20 years old and can be assumed to be failing because of lack of maintenance;
  - Poorly drained soils (See *Figure III-6 – Soil Drainage Classes*) throughout the watershed
- ALL Subwatersheds are considered to be highly critical (ranking of “1”) for private septic.

**3) Unlicensed Scrap Yards**

Confirmations of stakeholder information revealed unlicensed scrap yards located in Kettle Creek, Morrison Creek, and Tanyard Branch Subwatershed. Those areas were given a ranking of “1”

**(viii) Other**

As indicated in *5.08 Metals Levels in Non-mining Areas*, high levels of aluminum and iron were found in areas where mine sites were not known to exist. Those locations were in the Middle Fork and Tanyard Branch Subwatersheds – those areas received a ranking of “1”.

**Table VI-1 – Sources Associated with 12-digit Subwatersheds**

Concern	Subwatershed	12-Digit HUC	Sources																			
			Municipal Sanitary Sewer Systems	Stormwater Management	Dumping of Refuse	Private Septic Systems	Unlicensed Scrap Yards	Metals in Non-mining Areas	Road & Ditch Maintenance		Lawn / Landscaping		Logging / Land Clearing		Pasture Management		Unlimited Stream Access by Livestock		Ag-related Loss of Riparian Buffer Zones		Manure Applications	
	Chowning Creek - Busseron Creek	051201111501																				
	West Fork Busseron Creek	051201111502																				
	Headwaters Big Branch	051201111503																				
	Mud Creek - Big Branch	512011111504																				
	Sulfur Creek - Busseron Creek	512011111505																				
	Kettle Creek - Busseron Creek	512011111506																				
	Buttermilk Creek	512011111507																				
	Morrison Creek - Busseron Creek	512011111508																				
	Buck Creek - Busseron Creek	512011111509																				
	Middle Fork Creek	512011111510																				
	Rogers Ditch**	512011111511																				
	Tanyard Branch - Busseron Creek	512011111512																				

Priority Level

- 1
- 2
- 3
- \*\*

Added after TMDL

### (c) Identification and Ground Truthing

Parameters associated with Concerns (*Table V-1 – Parameters Associated with Concerns*) were used along with Source Locations (*Table VI-1 – Sources Associated with 12-digit Subwatersheds*) to identify expected pollutants and their sources.

This information was then ground-truthed, or verified.

Testing sites, including the BCWP results, TMDL, USGS, and AML sites were assembled and loads calculated based upon:

1. Stream flow at the sample site (CFS)
2. Load area (drainage area of sample site)

(Data may be found in Appendix B)

Seasonal and annual load averages were calculated. (See table XI – A) Due to unseasonable farming conditions in the 2008 and 2009 seasons, STEP-L (US EPA), Watershed Treatment Model (Center for Watershed Protection) and PRedICT (Pennsylvania State University) models were utilized to develop expected loads of Nitrogen and Phosphorus. These models were also utilized to predict Sediment loads. The sites were then assembled into their associated 12-digit watershed.

Loads were compared to expected parameter concerns based upon land use. In general, this information corroborated assumptions made based upon land use. A single series of unexpected results were found in the Middle Fork and Robbins Branch Subwatersheds. The source of high metals concentrations is unknown, but presumed to be abandoned mine land related.

### (d) Ranking

A combination GIS analysis of land uses as described in Section 6.01(c), benchmark water quality data (Section IV Benchmark Water Quality Assessment) and modeling as described above was used to ground-truth expected impairments. The subwatersheds were then given a ranking by parameter based upon a combination of:

1. State of Indiana Water Quality Standards (IAC 327-2-1).
2. Average Indiana Levels
3. Comparative ranking within the 10-digit Busseron Creek Watershed.

Those Subwatersheds showing recurring or critical levels of contamination were identified as higher-ranking priority areas.

- Priority 1: Highly Critical – Very Poor Condition
- Priority 2: Critical – Poor Condition
- Priority 3: Fair Condition
- Priority 4: Good Condition.

Ranking for each parameter is discussed in the following section and has been summarized in *Table VI-2 – Parameter-based Critical Watersheds*

**Table VI-2 – Parameter-based Critical Watersheds**

Subwatershed	12-Digit HUC	Parameter										
		Habitat Quality	Temperature	Dissolved Oxygen	pH	Turbidity	Total Suspended Solids	Total Dissolved Solids	E. Coli	Sediment	Nutrient (N)	Nutrient (P)
Chowning Creek - Busseron Creek	051201111501	○	○	●	○	○	●	○	●	●	●	●
West Fork Busseron Creek	051201111502	○	○	●	○	○	○	●	○	●	●	●
Headwaters Big Branch	051201111503	○	●	○	●	●	●	○	○	○	○	○
Mud Creek - Big Branch	051201111504	○	●	●	●	●	●	○	○	○	●	●
Sulfur Creek - Busseron Creek	051201111505	○	●	●	●	●	●	○	●	○	○	●
Kettle Creek - Busseron Creek	051201111506	○	●	○	○	○	○	○	●	○	●	●
Buttermilk Creek	051201111507	○	○	○	○	○	○	○	○	○	○	○
Morrison Creek - Busseron Creek	051201111508	●	●	○	○	○	○	●	○	●	○	●
Buck Creek - Busseron Creek	051201111509	●	○	●	○	○	●	●	○	●	●	○
Middle Fork Creek	051201111510	●	○	○	○	○	●	●	●	●	●	○
Rogers Ditch**	051201111511	●	○	○	●	○	○	○	●	●	●	●
Tanyard Branch - Busseron Creek	051201111512	●	○	●	●	○	○	●	●	●	●	●

Critical Priority

1	●	Highly Critical - Very Poor Condition
2	●	Critical - Poor Condition
3	○	Fair Condition
4	○	Good Condition

## (e) Critical Area Identification

In the following FiguresFigure VI-1 - Figure VI-13, Very Poor (Red Striped) and Poor (Red) Subwatersheds are considered to be critical for the parameter shown.

### (i) Habitat Quality

#### *Figure VI-1 – Habitat Quality*

Habitat Quality is a subjective parameter. Analysis and ranking were based upon CQHEI assessments, macroinvertebrate sampling, and tree cover analysis combined with windshield surveys of riparian buffers, bank erosion, and channelization of streams.

Available through Hoosier Riverwatch, the CQHED was developed by the Ohio Environmental Protection Agency as a “Citizens” companion to the Qualitative Habitat Evaluation Index used by the state’s professional staff. Data sheets were modified from information provided by the Ohio EPA. The purpose of the index is to provide a measure of the stream habitat and riparian health that generally corresponds to physical factors affecting fish and other aquatic life (i.e. macroinvertebrates). Produces a total score that can be used to compare changes at one site over time or compare two different sites.

There is no current standard for canopy density. Natural breaks were utilized to develop classification levels. Windshield surveys were used to ground truth GIS analysis of canopy density as well as note riparian buffer quality, bank erosion and channelization of streams.

Benthic Macroinvertebrate sampling results were compiled utilizing the Hoosier Riverwatch Biological Monitoring Data Sheet (2008 Volunteer Stream Monitoring Training Manual) and were used to corroborate other findings.

## Habitat Quality

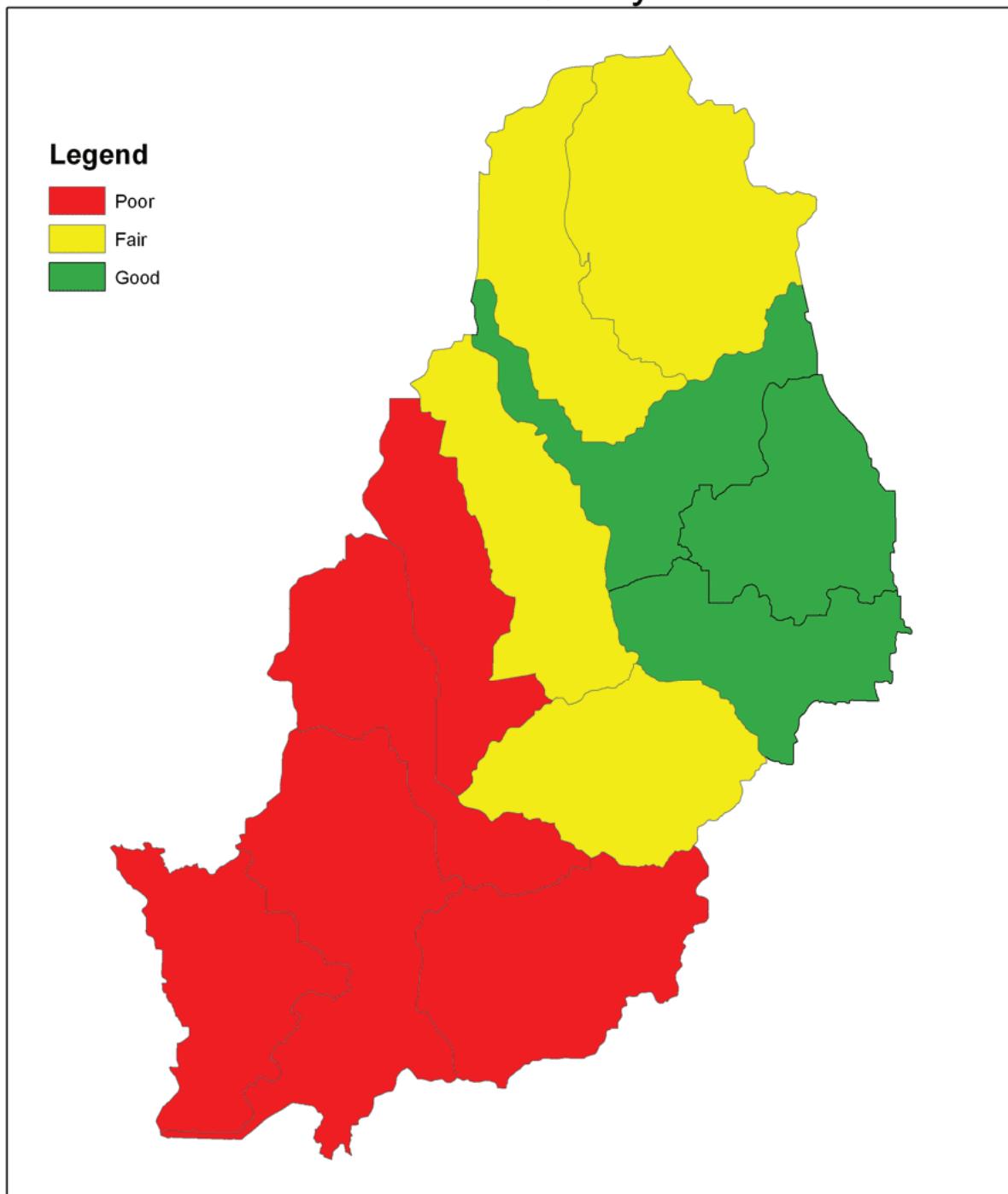


Figure VI-1 – Habitat Quality

**(ii) Temperature**

*Figure VI-2 – Temperature*

From 327-IAC 2-1-6(b):

*The following are conditions for temperature:*

- E. *There shall be no abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions.*
- F. *The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained.*
- G. *The maximum temperature rise at any time or place above natural temperatures shall not exceed:*
  - i. *five (5) degrees Fahrenheit (two and eight-tenths (2.8) degrees Celsius) in streams; and*
  - ii. *three (3) degrees Fahrenheit (one and seven-tenths (1.7) degrees Celsius) in lakes and reservoirs.*
- H. *Water temperatures shall not exceed the maximum limits in the following table during more than one percent (1%) of the hours in the twelve (12) month period ending with any month. At no time shall the water temperature at such locations exceed the maximum limits in the following table by more than three (3) degrees Fahrenheit (one and seven-tenths (1.7) degrees Celsius):*

Month	Ohio River Main Stem °F(°C)	Other Indiana Streams °F(°C)
January	50 (10.0)	50 (10.0)
February	50 (10.0)	50 (10.0)
March	60 (15.6)	60 (15.6)
April	70 (21.1)	70 (21.1)
May	80 (26.7)	80 (26.7)
June	87 (30.6)	90 (32.2)
July	89 (31.7)	90 (32.2)
August	89 (31.7)	90 (32.2)
September	87 (30.7)	90 (32.2)
October	78 (25.6)	78 (25.5)
November	70 (21.1)	70 (21.1)
December	57 (14.0)	57 (14.0)

No Subwatersheds were found to be critical for temperature. All Subwatersheds fell within Indiana standards. Only those Subwatersheds affected by removal of tree canopy over streams and concentrations of upstream impervious surfaces exhibited elevated temperatures. Ranking was based upon average June-September temperatures.

Fair = 68°F – 73°F

Good = <68°F

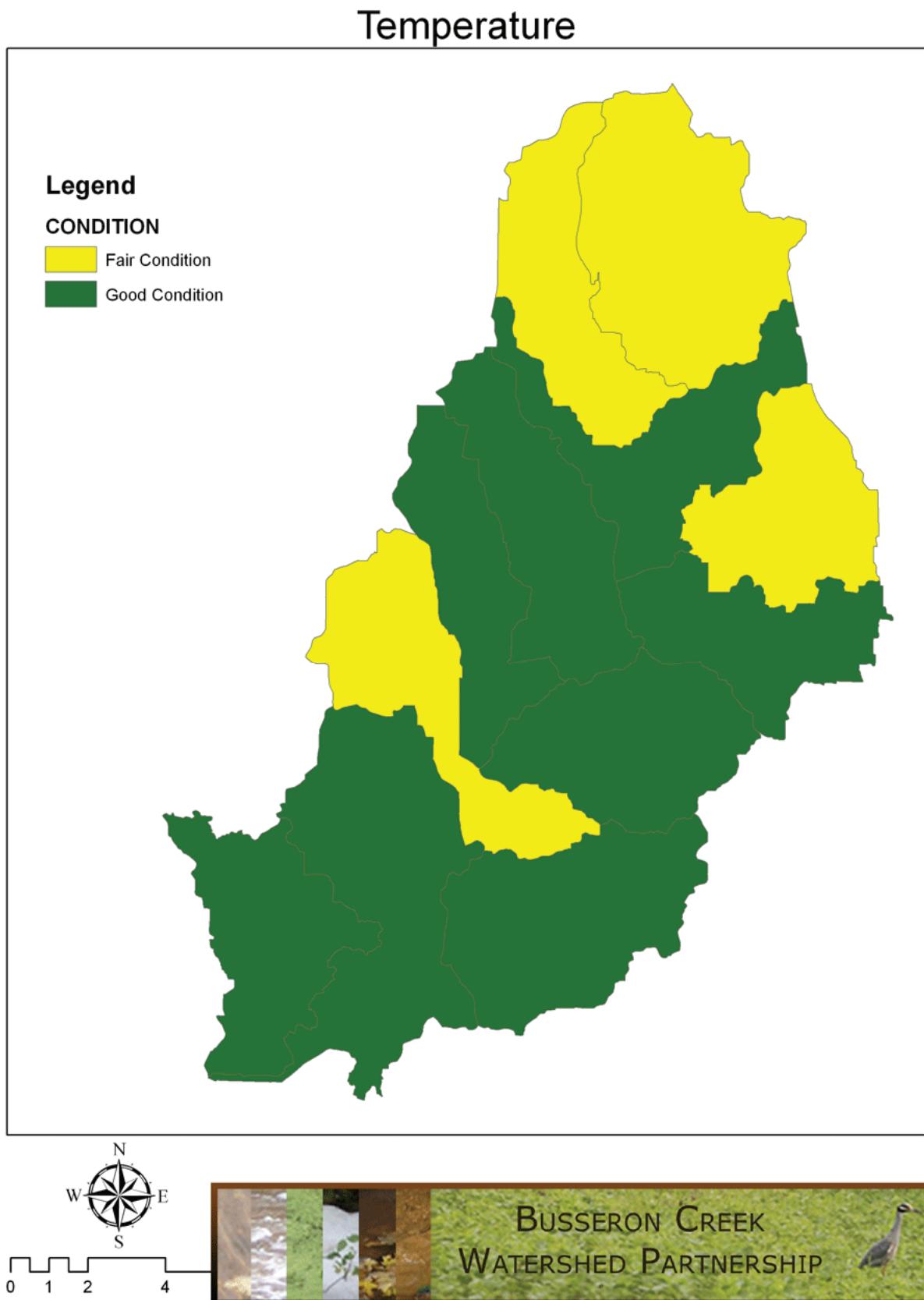


Figure VI-2 – Temperature

### (iii) Dissolved Oxygen

#### *Figure VI-3 – Dissolved Oxygen*

From 327-IAC-2-1-6(b):

*Concentrations of dissolved oxygen shall:*

- A. *Average at least five (5.0) milligrams per liter per calendar day; and*
- B. *Not be less than four (4.0) milligrams per liter at any time.*

Dissolved Oxygen loads appeared to be most greatly impacted by nutrient loads, especially those associated with sanitary sewer and private septic loads.

Although some sites were found to exceed standards, ranking was based upon improvements needed to reach annual Indiana D.O. average of 9.8 mg/L (per Hoosier Riverwatch Volunteer Stream Monitoring Training Manual)

Highly Critical / Very Poor = >20%

Critical / Poor = 10% – 20%

Fair = 5% - 9%

Good = <5%

## Dissolved Oxygen

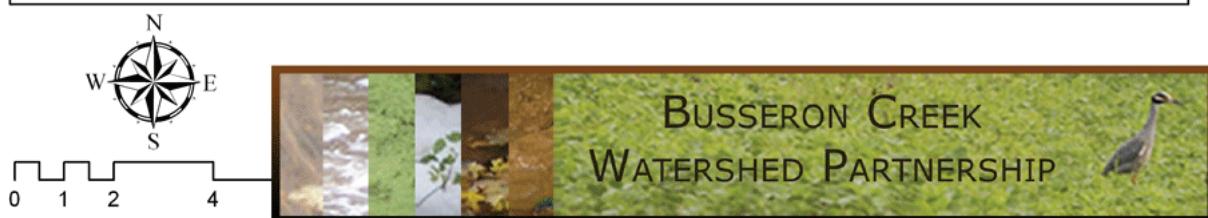
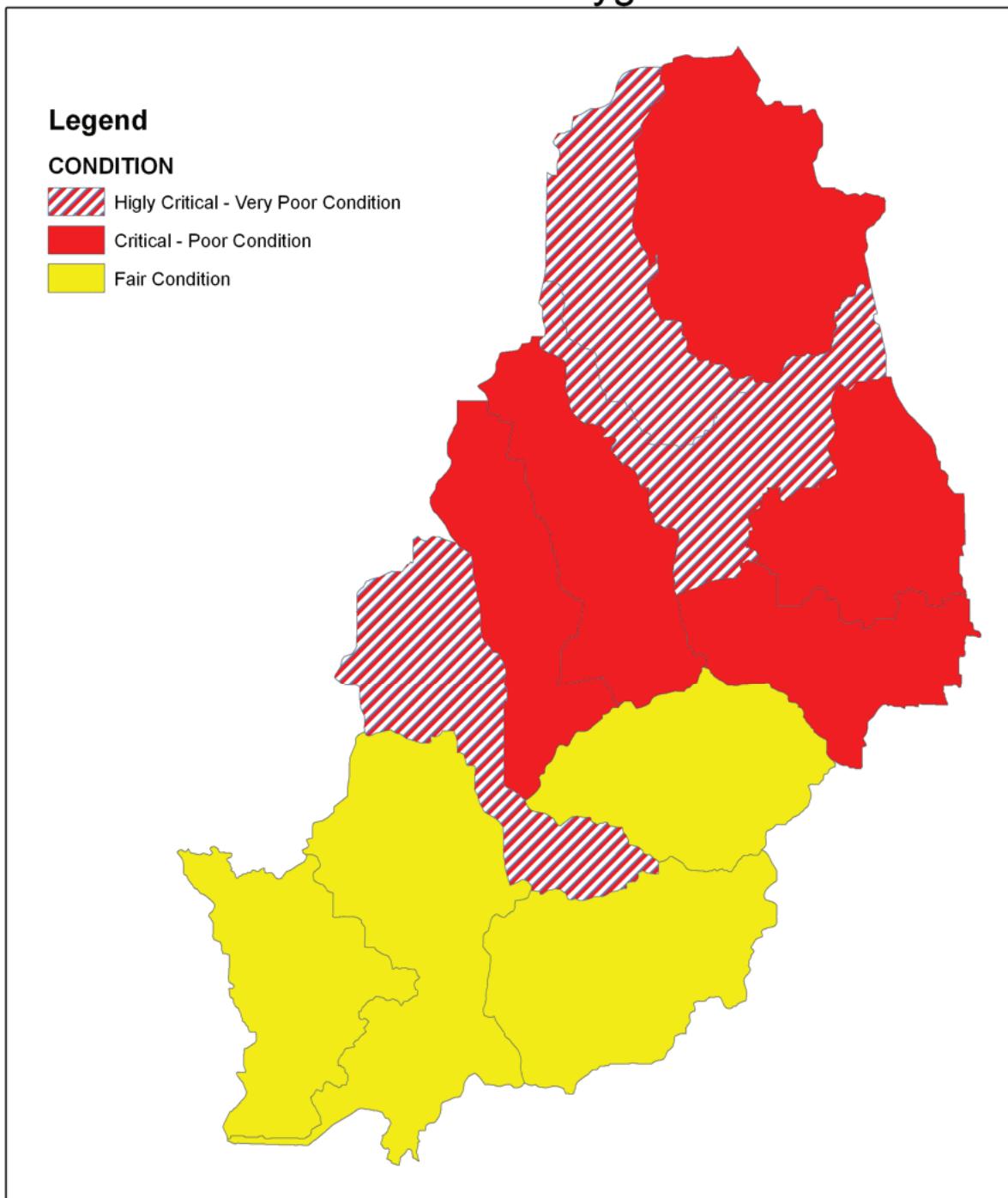


Figure VI-3 – Dissolved Oxygen

**(iv) pH**

*Figure VI-4 – pH*

From 327-IAC-2-1-6(b):

*No pH values below six (6.0) or above nine (9.0), except for daily fluctuations that:*

- A. *exceed pH nine (9.0); and*
- B. *are correlated with photosynthetic activity.*

pH levels appear to be most greatly impacted by acid mine drainage. The Mud Creek and Sulfur Creek areas (Draft TMDL / DNR – Division of Reclamation data) are severely impacted by AML sites. With an average pH of 7.03, Morrison Creek may be somewhat impacted by the Jonay AML site northeast of Sullivan Lake. West Fork Busseron pH levels are slightly elevated (8.00) and may be impacted by surface mining operations upstream from sampling sites. Ranking was based upon averages of pH testing results.

Highly Critical / Very Poor = any sample <4.0

Critical / Poor = not assigned

Fair = average <7.1, >7.99

Good = average 7.1 – 7.99

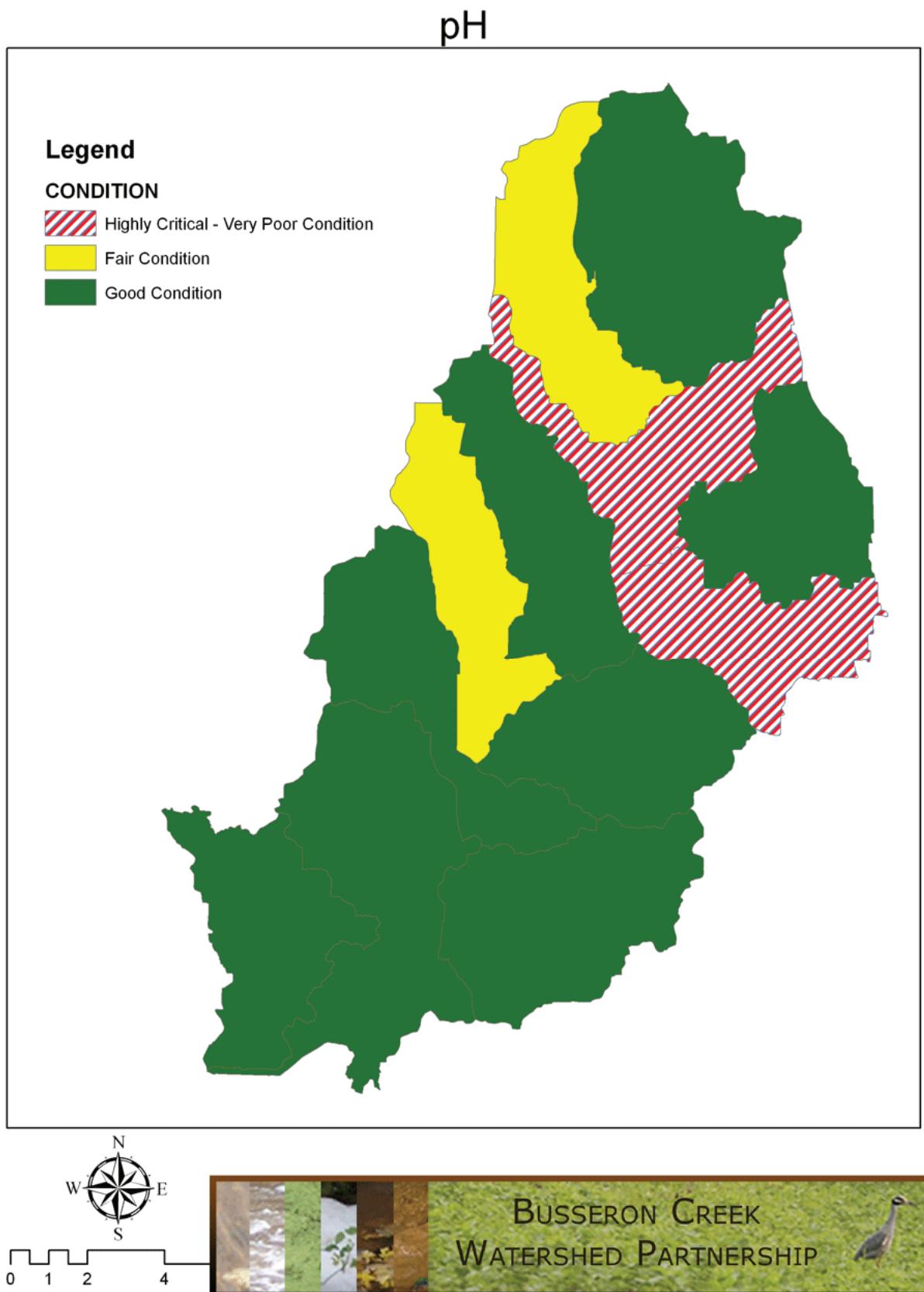


Figure VI-4 – pH

**(v) Turbidity**

*Figure VI-5 – Turbidity*

Classification is based upon average of April – October sampling events.

Subwatersheds with the greatest turbidity issues appear to be those most highly impacted by AMD. It should be noted that extreme turbidity of BCW site number 5 had a significant impact on Tanyard Branch turbidity averages. Ranking was based upon reductions required to attain an average of less than 36 NTU (Indiana average, per Hoosier Riverwatch Volunteer Monitoring Training Manual) from April to October.

Highly Critical / Very Poor = >80%

Critical / Poor = 50% - 80%

Fair = 1% - 49%

Good = no reductions required

## Turbidity

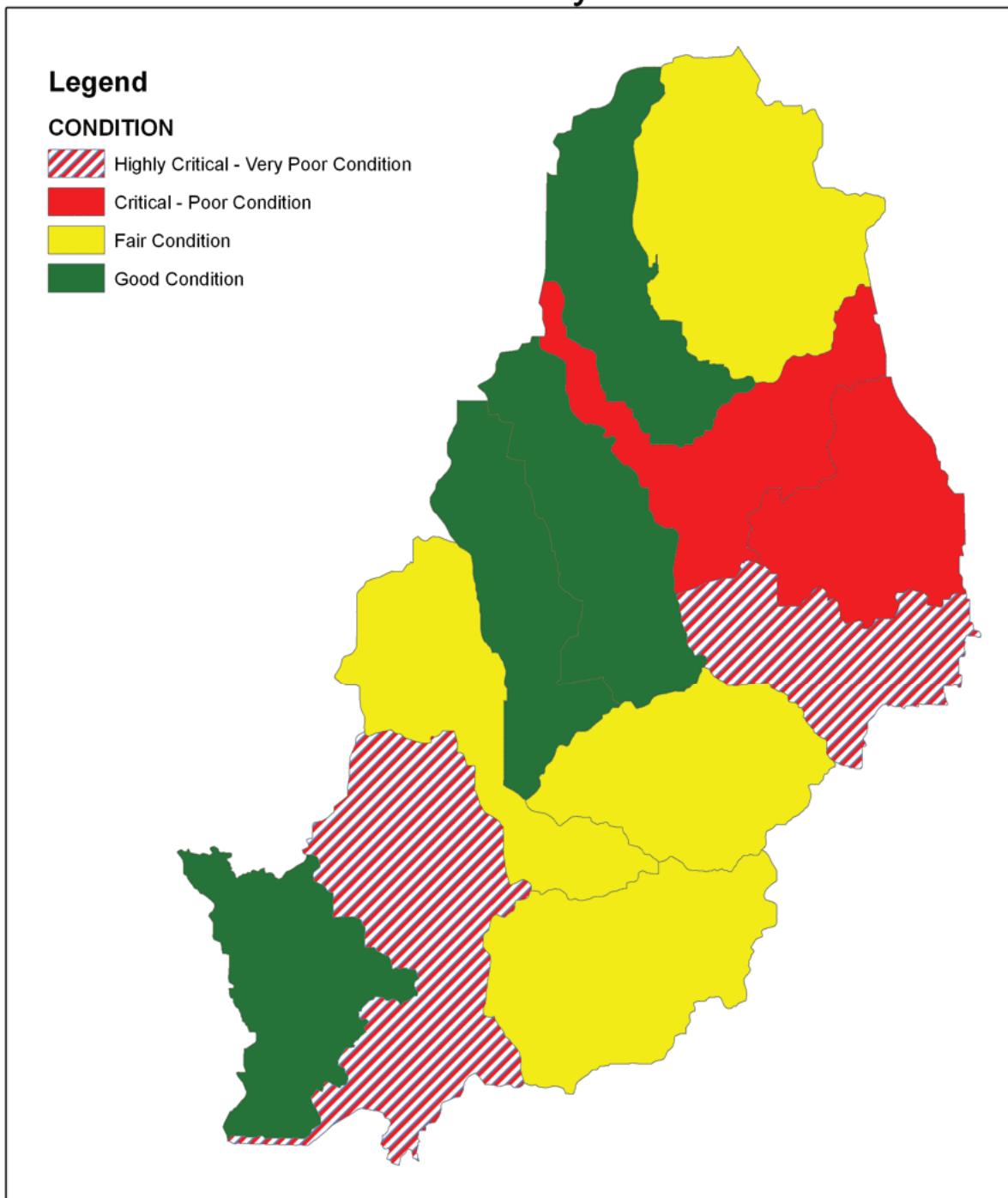


Figure VI-5 – Turbidity

**(vi) Total Suspended Solids**

*Figure VI-6 – Total Suspended Solids*

Loads of suspended solids were developed from sampling events.

Subwatersheds most greatly impacted by TSS are also greatly impacted by AML. TSS levels may be due in part to precipitation of metals as stream-levels of AMD are diluted. Watersheds with high TSS levels are also highly impacted by WWTPs, CSOs, and private septic systems and to a lesser extent (in Kettle Creek & Buck Creek) by livestock management. Ranking was based upon reductions required to reach an average of less than 30 mg / L (draft Indiana TMDL target load).

Highly Critical / Very Poor = >80%

Critical / Poor = 30% - 80%

Fair = 1% - 29%

Good = no reductions required

## Total Suspended Solids

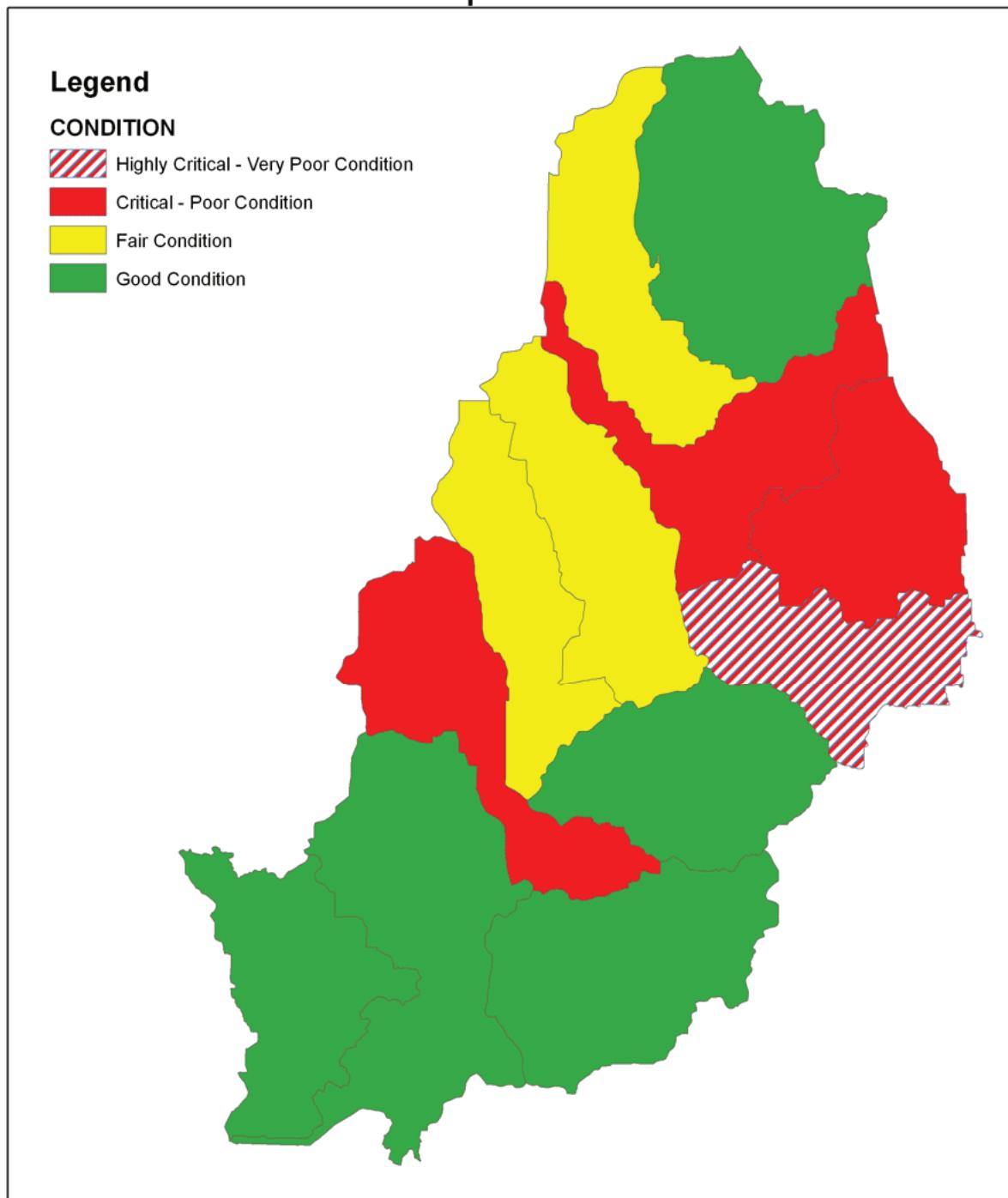


Figure VI-6 – Total Suspended Solids

**(vii) Total Dissolved Solids**

*Figure VI-7 – Total Dissolved Solids*

From 327-IAC 2-1-6(e):

*The concentration of dissolved solids shall not exceed seven hundred fifty (750) milligrams per liter unless due to naturally occurring sources. A specific conductance of one thousand two hundred (1,200) micromhos per centimeter (at twenty-five (25) degrees Celsius) may be considered equivalent to a dissolved solids concentration of seven hundred fifty (750) milligrams per liter.*

Subwatersheds most greatly impacted by TDS are generally associated with AML. Ranking was based upon reductions required to reach an average of less than 500 mg / L

Critical / Poor = >30%

Fair = 1% - 30%

Good = no reductions required

## Total Dissolved Solids

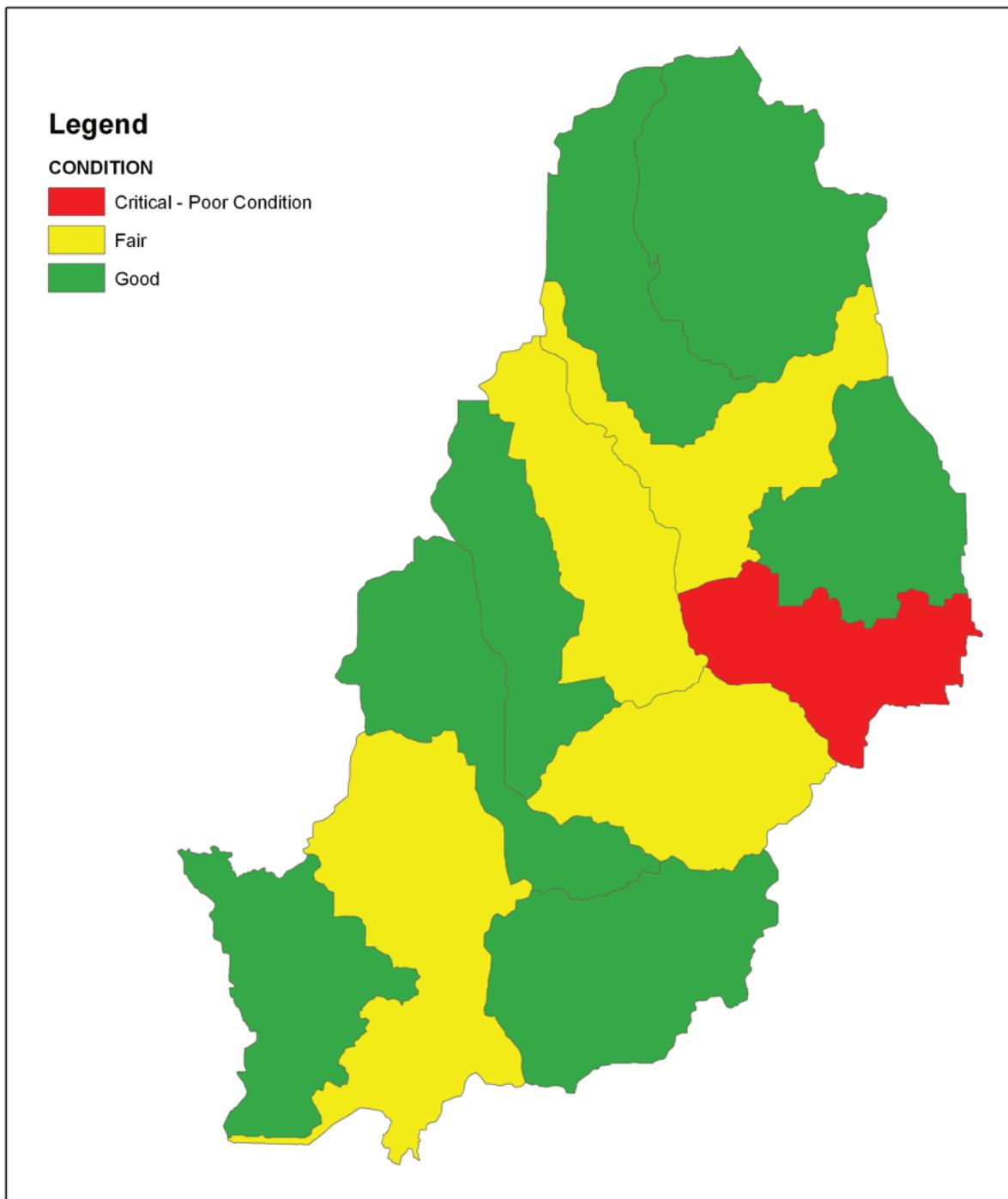


Figure VI-7 – Total Dissolved Solids

(viii) E. Coli

*Figure VI-8 – E. coli*

From 327-IAC 2-1-6(d):

- For full body contact recreational uses, E. coli bacteria shall not exceed the following:*
- C. One hundred twenty-five (125) per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period.
  - D. Two hundred thirty five (235) cfu or MPN per one hundred (100) milliliters where the:
    - i. E. coli exceedances are incidental and attributable solely to E. coli resulting from discharge of treated wastewater from a wastewater treatment plant as defined in IC 13-11-2-258; and
    - ii. Criterion in clause (A) is met.

Critical area identification for E. coli was based upon BCW sampling. There was not enough data to evaluate Buttermilk Creek and Mud Creek for E. coli levels. Areas most critical for E. coli appear to be those subwatersheds affected by CSOs (Buck Creek) and concentrations of private septic systems combined with poor soil drainage classes. Ranking was based upon reductions required to attain an average 235CFU from April – October.

Highly Critical / Very Poor = 99%;

Buck Creek & Middle Fork Creek for no. samples exceeding 2400CFU

Critical / Poor = 75% - 98%

Fair = 1% - 75%

## E. coli

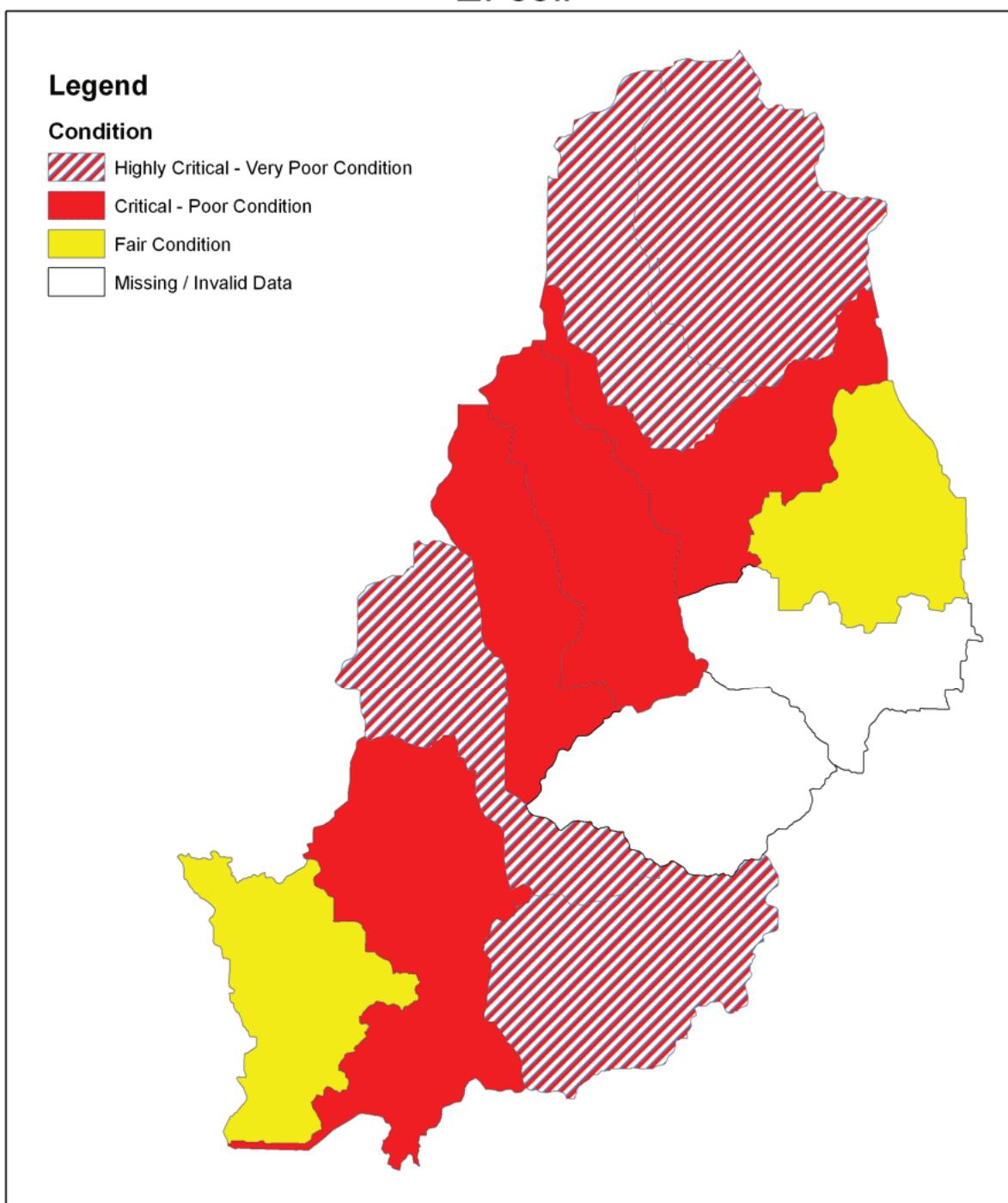


Figure VI-8 – E. coli

**(ix) Sediment**

*Figure VI-9 – Sediment*

Sediment loads were developed from STEP-L modeling and were used to calculate erosion losses.

Sediment loads were most highly impacted by channel / bank erosion followed by agricultural practices.  
Ranking was based upon reductions required to reduce *total* watershed sediment loads by 20%.

Highly Critical / Very Poor = >1000 lbs/Ac

Critical / Poor = 900 – 1000 lbs / Ac

Fair = 400 – 899 lbs / Ac

Good = < 400 lbs / Ac

## Sediment

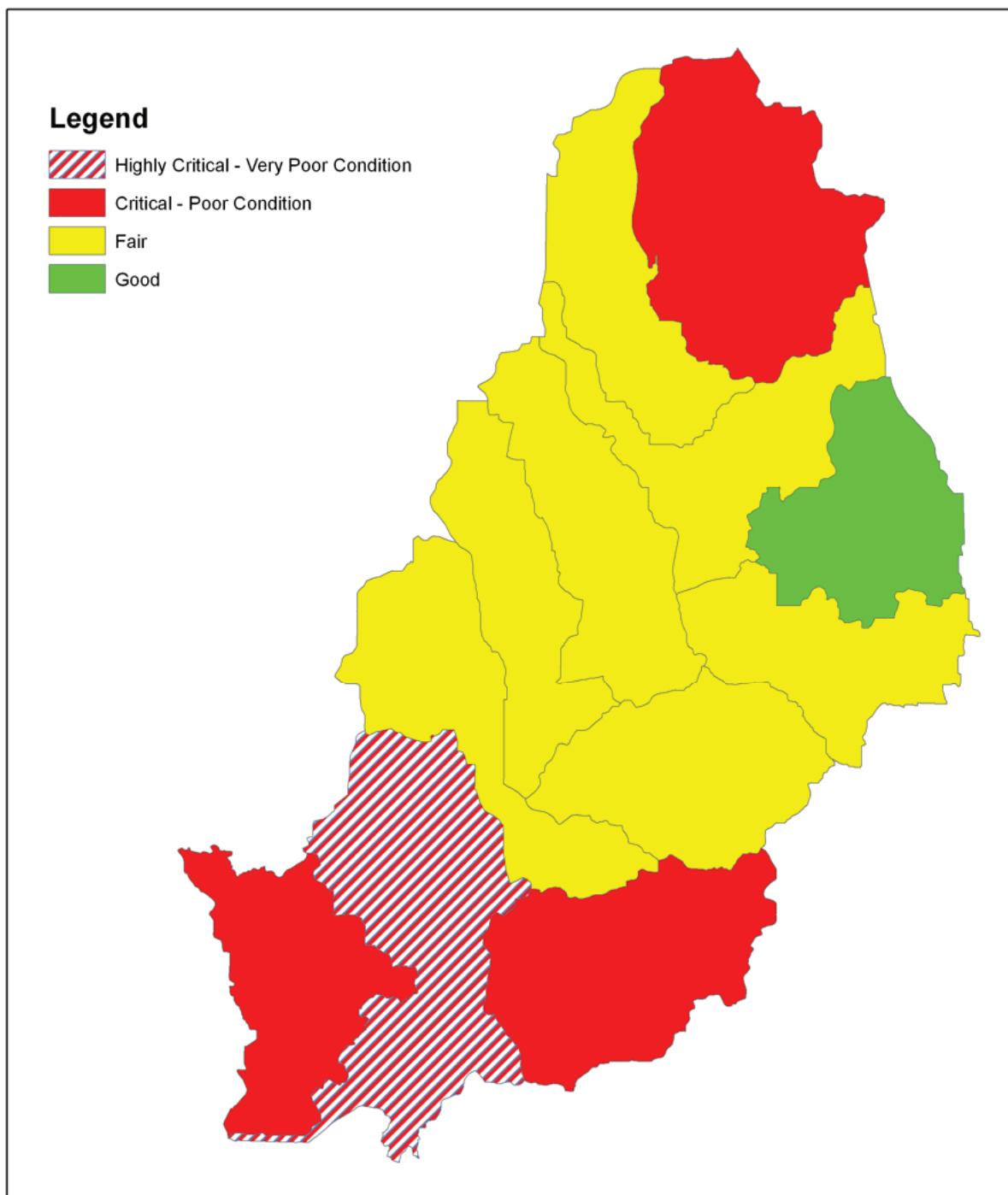


Figure VI-9 – Sediment

**(x) Nutrient (N)**

*Figure VI-10 – Nutrient (N)*

Nitrogen loads were calculated using Center for Watershed Protection Watershed Treatment Model and STEP-L modeling. Primary loads were primarily agricultural followed by septic (based upon land use analysis). Because it is impossible to accurately predict mg/L loading from models, general reductions were allocated to each watershed. Ranking was based upon these general reductions.

Critical / Poor = >30%

Fair = 20% – 30%

Good = < 20%

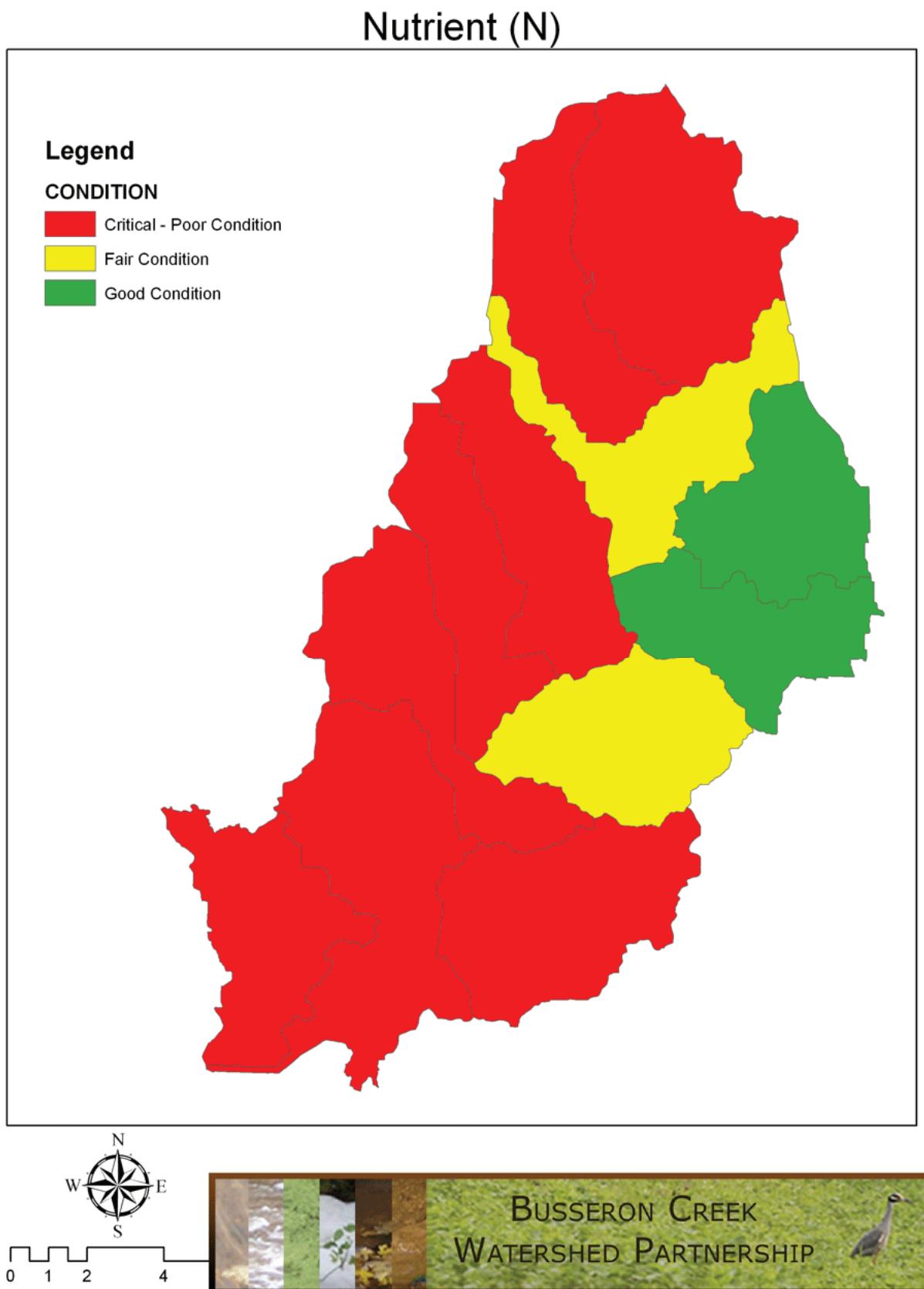


Figure VI-10 – Nutrient (N)

**(xi) Nutrient (P)**

*Figure VI-11 – Nutrient (P)*

Phosphorus loads were calculated using STEP-L modeling. Primary loads were primarily agricultural with slight septic pressure (based upon land use analysis). Because it is impossible to accurately predict mg/L loading from STEP-L models, general reductions were allocated to each watershed. Ranking was based upon these general reductions.

Critical / Poor = >30%

Fair = 20% – 30%

Good = < 20%

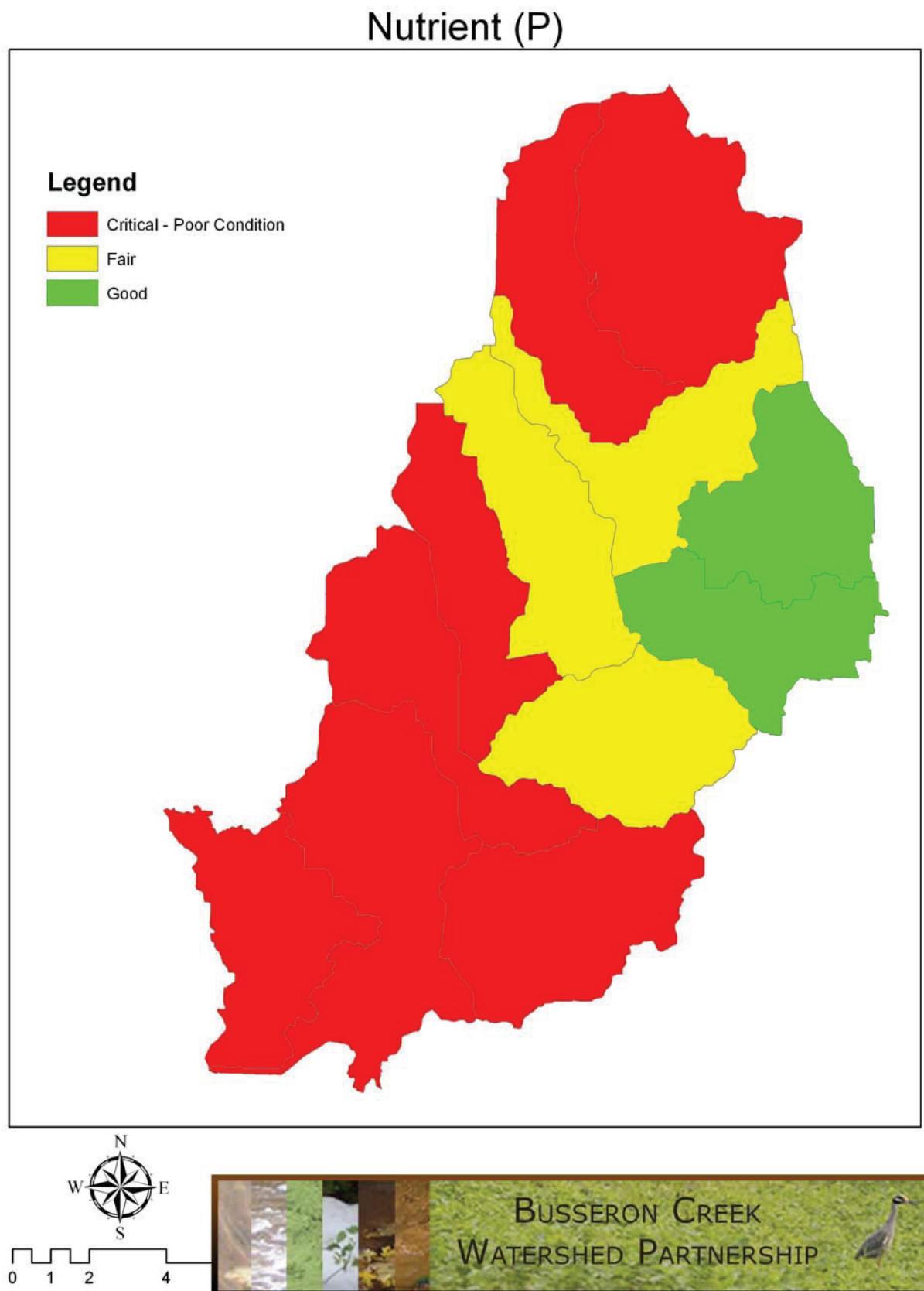


Figure VI-11 – Nutrient (P)

**(xii) Aluminum**

*Figure VI-12 – Aluminum*

The target value of 174 $\mu\text{g} / \text{L}$  is a numeric criterion developed by IDEM following the process explained in 327 IAC 2-1-8. Details may be found in the Busseron Creek Watershed Draft TMDL report developed by IDEM and dated September 2008.

Aluminum loads in the Busseron Creek Watershed appear to be associated with acid mine discharge and septic issues. Ranking is based upon reductions required to meet Indiana targets of 174 $\mu\text{g} / \text{L}$ .

Highly Critical / Very Poor = >90%

Critical / Poor = 80% - 90%

Fair = 6% - 79% (one watershed at 49%)

Good = < 5%

## Aluminum

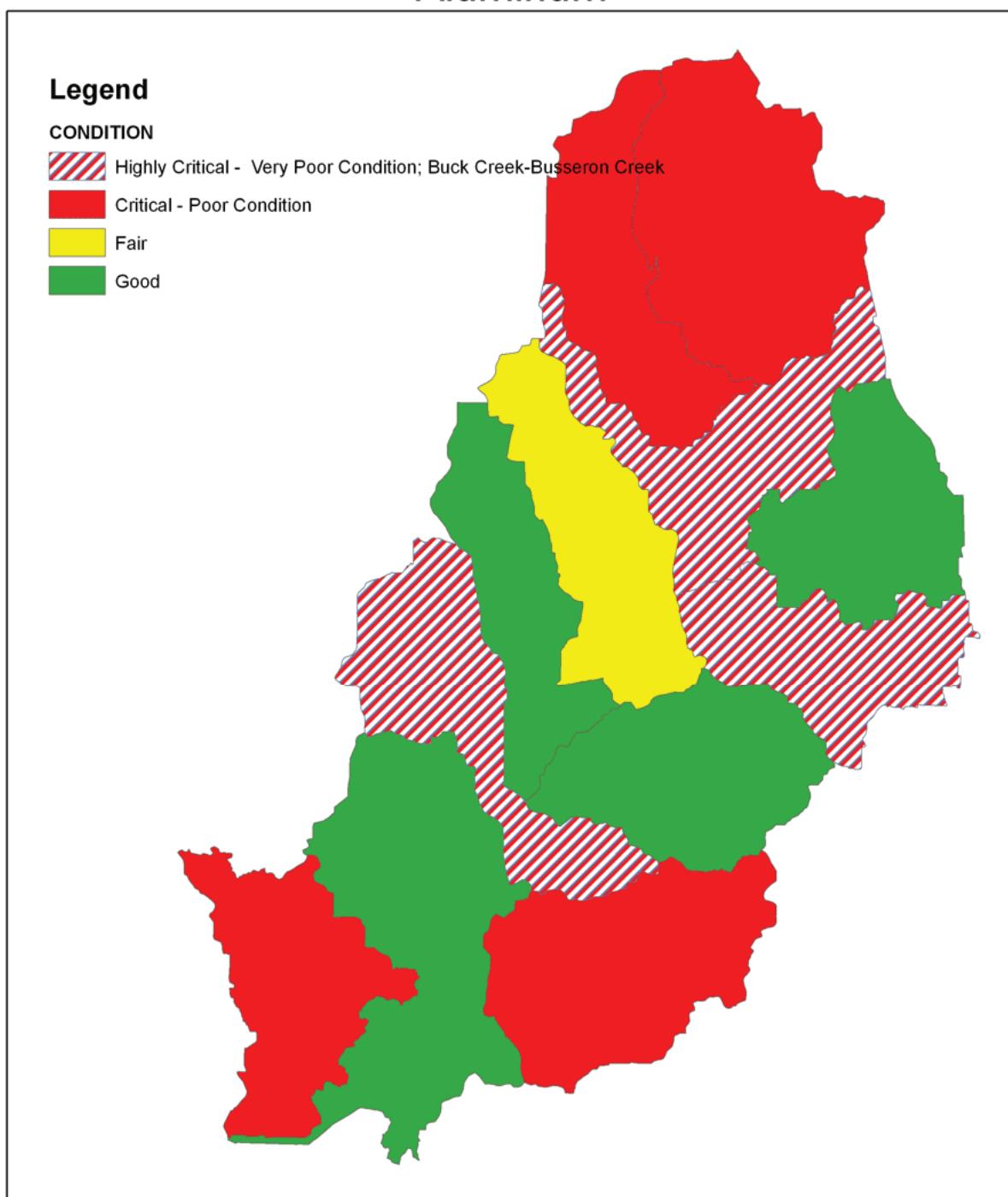


Figure VI-12 – Aluminum

**(xiii) Iron**

*Figure VI-13 - Iron*

The target value of 2.5 mg/L is a numeric criterion developed by IDEM following the process explained in 327 IAC 2-1-8. Details may be found in the Busseron Creek Watershed Draft TMDL report developed by IDEM and dated September 2008.

Iron loads are typically associated with Acid Mine Discharge, however BCW sampling results may indicate iron loading associated with urban uses. Subwatershed ranking was based upon reductions required to meet the target of 2.5 mg/L.

Highly Critical / Very Poor = >90%

Critical / Poor = 70% - 90%

Fair = 16% - 69% (one watershed at 49%)

Good = no reductions required

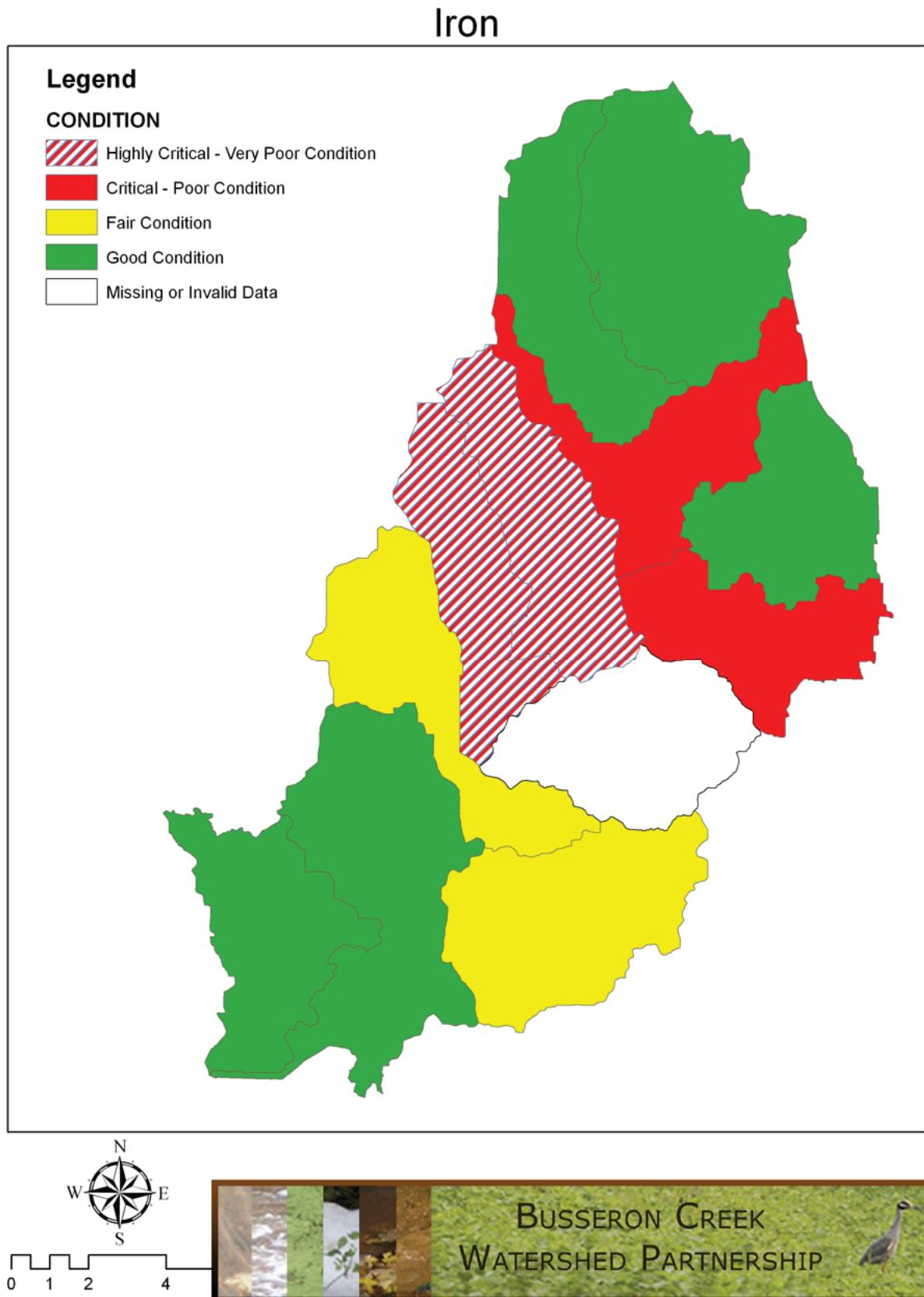


Figure VI-13 - Iron

## 6.02 Other Considerations

Best Management Practices (BMP) implementation must address one or more parameters identified as critical for the subwatershed in which the practice will be put into service.

It is recommended that BMP promotion be more narrowly focused on land uses and/or stream reaches and drainage areas to more successfully effect water quality improvements. Factors affecting BMP implementation include:

1. Landowner and/or land manager interest in conservation planning and BMP implementation
2. The ability to leverage a variety of programs and funding sources
3. The availability of programs to address source concerns
4. Population demographics, especially the financial ability of landowners to meet program requirements, such as cost-share.
5. Expected lifespan of BMP compared to expected land uses changes – such as surface mining operations or municipal development.

With the exception of items 4 and 5, these factors are dynamic in nature. In general, the dynamics revolve around financial aspects of participation such as:

- State or Federal tax credits
- Natural Resources Conservation Service programs and incentives
- Indiana Department of Natural Resources – Division of Fish & Wildlife programs, incentives, and technical services
- Indiana Department of Natural Resources – Division of Reclamation programs
- Indiana State Department of Agriculture programs
- Rural Development programs and grants
- US Fish & Wildlife Service programs and technical services
- Clean Water Act Section 401/404 mitigation needs
- Clean Water Act Section 319 programs

It is also expected that Mississippi River Basin Initiative programs and “Cap & Trade” legislation will impact the depth and variety of tools with which BMPs may be deployed.

For many reasons, including those listed above, BMP promotional strategies should be identified and reviewed at the time of major program or legislative changes. The Goals, Objectives, and Tasks identified in Section VII should be used a guideline for BMP promotional strategy design. At minimum, review and revision of BMP promotional strategies should take place annually.

These strategies will help to insure that BMP implementation will occur in concentrated, rather than sporadic, physical areas, resulting in measurable water quality improvements.

## 6.03 Suggested Reductions

Results from the Benchmark Water Quality Assessment (*Section IV -Benchmark Water Quality Assessment*) were used as a baseline for current pollutant loads. *Table VI-3 – Loads and Suggested Reductions* summarizes loads developed from the complete benchmark assessment. This table also summarizes reductions required to meet the standards listed in *Section 6.03(a)- Basis for Suggested Reductions*.

### (a) Basis for Suggested Reductions

Dissolved Oxygen:	to reach annual average for Indiana
pH:	to reach pH 7.5
Turbidity:	to reach an average of <36 NTU
TSS:	to reach average of 20 mg / L
TDS:	to reach average of 500 mg / L
E. coli:	to reach average of 235 cfu / L (Apr – Oct)
Sediment:	an overall reduction of 20% pro-rated among Subwatersheds
Nitrogen:	general reduction * <i>Unable to accurately predict mg/L from STEP-L model</i>
Phosphorus:	general reduction * <i>Unable to accurately predict mg/L from STEP-L model</i>
Aluminum:	to reach an average of <174 µg/L
Iron:	to reach an average of <2.5 mg / L

## (b) Suggested Reductions

**Table VI-3 – Loads and Suggested Reductions**

Parameter Standard Source	DO 9.8 mg / L IN Annual Ave.	pH >6. <9 327 IAC 2-1-6	Turbidity <36 NTU 327 IAC 2-1-6	TSS <30 mg / L 327 IAC 2-1-6	TDS <750 mg / L 327 IAC 2-1-6	E. coli < 235 cfu 327 IAC 2-1-6	Reduction	
							Average mg / L Improvement	Ave # / AC / Year Reduction
<b>Subwatershed Name</b>								
HUC 12								
Chowning Creek - Busseron Creek	05/20/1111501	8.77	11% 7.62	2% 37.13	3% 15.54	22,029.89	210.17	365.79 99%
West Fork Busseron Creek	05/20/1111502	6.23	36% 8.00	7% 26.38	21.27	7,198.45	6%	413.25 59%
Headwaters Big Branch	05/20/1111503	7.89	19% 7.66	2% 57.37	59% 33.50	120,075.95	68%	274.27 453.33
Mud Creek - Big Branch	05/20/1111504	8.84	10% 6.82	9% 71.45	98% 58.33	249.54	99%	662.24 32%
Sulfur Creek - Busseron Creek	05/20/1111505	7.78	21% 6.87	8% 55.52	54% 35.60	5,736.21	78%	494.10 166.91
Kettle Creek - Busseron Creek	05/20/1111506	8.44	14% 7.53	3% 49.14	3% 15.50	12,306.96	13%	18% 120.12
Buttermilk Creek	05/20/1111507	8.93	9% 7.73	3% 49.14	37% 15.50	2,92	569.24	14%
Morrison Creek - Busseron Creek	05/20/1111508	8.44	14% 7.03	6% 20.70	22.80	121.89	14%	419.02
Buck Creek - Busseron Creek	05/20/1111509	7.13	27% 7.62	2% 45.79	27% 26.37	12,107.07	32%	225.52 2,814.70
Middle Fork Creek	05/20/1111510	8.93	9% 7.73	3% 45.79	26% 16.00	12,736.30	38%	12,371.39 79%
Rogers Ditch	05/20/1111511	9.36	5% 7.63	2% 16.94	12% 12.00	16,553.66	333.94	7,378.73
Tanyard Branch - Busseron Creek	05/20/1111512	9.04	8% 7.70	3% 65.42	82%	7.60	76,045.11	534.17 7%
								772.44 30%

Parameter Standard Source	Sediment 20% Total Reduction	Nitrogen* < 10 mg / LN02-NO3 327 IAC 2-1-6	Phosphorus* < 0.3 mg / L 327 IAC 2-1-6	Aluminum < 174 ug/L 327 IAC 2-1-6	Iron < 2.5 mg / L 327 IAC 2-1-6	Reduction		
						# / Acre / Year STEPL Model)	Tons / Year STEPL Model)	# / Acre / Year STEPL Model)
<b>Subwatershed Name</b>								
HUC 12								
Chowning Creek - Busseron Creek	05/20/1111501	6,558.48	679.18	51.21	5.30	35% 12.18	8%	6.38 # / 0.79
West Fork Busseron Creek	05/20/1111502	4,061.87	694.54	10% 31.22	5.34	35% 7.86	9%	2.88 # / 0.79
Headwaters Big Branch	05/20/1111503	2,286.63	394.19	2% 14.38	2.48	16% 3.88	4%	1.19 # / 0.67
Mud Creek - Big Branch	05/20/1111504	2,569.92	473.97	3% 13.80	2.55	17% 3.75	5%	6.19 # / 0.69
Sulfur Creek - Busseron Creek	05/20/1111505	4,519.69	732.59	13% 26.66	4.32	29% 6.80	1.10	7% # / 0.47
Kettle Creek - Busseron Creek	05/20/1111506	3,579.44	557.01	8% 30.82	4.80	32% 7.05	1.10	7% # / 0.51
Buttermilk Creek	05/20/1111507	3,598.67	538.95	8% 25.75	3.86	26% 6.23	0.93	6% # / 0.74
Morrison Creek - Busseron Creek	05/20/1111508	3,958.52	740.78	10% 28.74	5.38	36% 6.91	1.29	9% # / 0.74
Buck Creek - Busseron Creek	05/20/1111509	5,647.83	871.59	15% 39.61	6.11	40% 9.72	1.50	10% # / 0.35
Middle Fork Creek	05/20/1111510	7,256.22	917.99	23% 45.30	5.73	38% 10.60	1.34	9% # / 0.65
Rogers Ditch	05/20/1111511	5,912.07	986.99	20% 37.13	6.20	41% 9.03	1.51	10% # / 0.26
Tanyard Branch - Busseron Creek	05/20/1111512	10,366.10	1,042.65	40% 54.54	5.49	36% 13.94	1.40	9% # / 0.26
								4.40 # / 0.31

\* General Reduction. Unable to accurately predict mg/L from STEPL Model values

## **Section VII. Watershed Management Goals & Indicators**

Throughout the Watershed Management Plan development process, the Steering Committee identified measures that could be implemented to reduce pollutant loads and improve water quality.

The Committee developed over-arching Goals to address specific pollutants. Ex: *Protect and improve water quality within the watershed by preventing E. Coli / bacteria from entering the system.*

Using the sources identified in Section V – Areas of Concern and parameters associated with those sources (6.01(a) - *Source Identification by Land Use*), the Committee developed source-based Objectives which needed to be met in order to fulfill defined Goals.. Ex: *Reduction / prevention of E. coli from failing septic systems from entering surface water is required to improve water quality by preventing E. coli / bacteria from entering the system.*

The Committee then developed specific Tasks necessary to meet the defined Objectives. Ex: *Local health department inspections of septic system design and installation is necessary to Reduce / prevent E. coli from failing septic systems from entering the surface water.*

The Committee then voted on Priority Levels of Tasks. Task-ranking decisions were based upon:

- Critical need – as defined by probable source and pollutant load
- Programmatic need – i.e. a task that must be completed before another can commence
- Effectiveness on pollutant load reductions
- Attainability

Goals, Objectives and Tasks were also developed to further define (more narrowly define) load sources and critical areas, increase the capacity of the watershed partnership, and assure sustainability of the group.

These Goals, Objectives, & Tasks are summarized in the Table comprising Section 7.01

The Table Comprising Section 7.02 Task Implementation and Indicators defines

- Key parties required to complete a task
- Timelines for BMP implementation, based upon priority levels set in Section 7.01
- Measurements of task completion or success
- Expected costs to complete a task and potential funding sources
- Expected pollutant load reductions associated with BMPs that may be used to reach Objectives.

## 7.01 Goals, Objectives, & Tasks

Goal	Objective	Task	Priority		
			High	Med	Low
Goal 1: To protect and improve water quality within the watershed by preventing E. coli / bacteria from entering the system.	Objective 1.1: Reduce / prevent E. coli from failing septic systems from entering surface water.	Task 1.1.1: Develop septic system management and design ordinances for local soils conditions, including “alternative” approaches such as composting, incineration, and wetlands systems.	◆◆		
		Task 1.1.2: Work with local health department to insure effective inspection of system design and installation.	◆	◆	
		Task 1.1.3: Work with local banks to insure septic service records and system inspection is a requirement for any home loans.	◆	◆	
		Task 1.1.4: Educate landowners with septic systems on their proper maintenance.	◆	◆	
	Objective 1.2: Reduce / prevent E. coli from CSOs from entering surface water.	Task 1.2.1: Work with businesses and landowners to insure that gutters are not connected to stormwater systems.	◆	◆	
		Task 1.2.2: Install public and private raingardens equal in volume to approximately 1% of roof and parking lot runoff.	◆	◆	
	Objective 1.3: Work with farmers and landowners to eliminate livestock impact on creeks, streams, and the ponds/lakes connected to creeks/streams.	Task 1.3.1: Implement structural BMPs (exclusionary fencing / watering facilities) in pastures with livestock access to surface waters.	◆	◆	
		Task 1.3.2: Work with landowners to insure that surface water runoff from feedlots, drylots, or other pasture/holding facilities do not directly enter surface waters.	◆	◆	
		Task 1.3.3: Work with farmers to implement manure management/application BMPs.	◆	◆	
	Objective 1.4: Reduce / prevent E. coli / bacteria from parks and park-like areas	Task 1.4.1: Work with DNR to promote available help for park and public area managers to eliminate/reduce wildlife (goose) waste runoff.	◆	◆	

		from entering surface water.	Task 1.4.2. Work with / distribute information to landowners to help them adopt management techniques to reduce/eliminate (goose) waste runoff.
	Goal 2: To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.	Objective 2.1: Identify and stabilize priority bank erosion sites through the installation of corrective measures.	Task 2.1.1: Implement structural BMPs to reduce the amount of sediment entering surface waters.
		Objective 2.2: Reduce impacts of stormwater runoff on bank erosion.	Task 2.1.2: Target riparian landowners with information regarding shoreline protection.
		Objective 2.3: Prevent / reduce erosion from farm fields.	Task 2.2.1: Work with landowners to restore streams to a more natural, meandering state to add storage capacity and slow velocity.
			Task 2.2.2: Work with landowners and municipalities to restore or construct wetlands to add storage capacity and slow velocity of stormwater runoff.
			Task 2.2.3: Implement agricultural BMPs such as no-till and cover crops to increase infiltration rate of precipitation.
			Task 2.2.4: Implement residential / urban BMPs such as rain gardens to increase infiltration rate of precipitation.
			Task 2.3.1: Implement agricultural BMPs such as no-till, cover crops, and ephemeral stream protection / grassed waterways to reduce surface water run-off and resulting soil erosion.
			Task 2.3.2: Work with landowners to strategically restore or construct sediment-trapping wetlands.
			Task 2.3.3: Work with landowners, Conservancy Districts, and Drainage Boards to restore riparian areas, including tertiary streams.
			Task 2.3.4: Implement BMPs to improve efficiency of irrigation systems and reduce surface water runoff and resulting soil erosion.
			Task 2.3.5: Increase grower participation in NRCS, DNR, and other conservation programs through strategic marketing.

<p><b>Objective 2.4:</b> Prevent / reduce erosion resulting from logging / land clearing activities.</p>	<p>Task 2.3.6: Participate in SWCD field days, agricultural customer appreciation days and similar events to highlight environmental and economic benefits of BMP implementation.</p> <p>Task 2.4.1: Host forestry workshops to demonstrate environmental and economic benefits of properly planned and conducted logging activities.</p> <p>Task 2.4.2: Work with DNR in development / promotion of certified forester assistance program to help landowners develop logging plans.</p>	<p>Task 2.4.2: Work with Sullivan County officials to clarify road and utility easements.</p>	<p>Task 2.5.1: Work with County Officials to develop and implement road &amp; ditch protection guidelines.</p>	<p>Task 2.5.2: Work with DNR and County Departments of Transportation to develop and implement low-cost, low-maintenance ditching solutions.</p>	<p>Task 2.5.3: Work with County Commissioners and Departments of Transportation to transition to improved road construction materials and methods.</p>	<p>Task 2.5.4: Work with County Commissioners and Departments of Transportation to transition to improved road construction materials and methods.</p> <p>Task 2.6.1: Work with coal mines to enroll farmlands under mine control into conservation programs.</p>	<p>Task 2.6.2: Launch outreach campaign to education farmers and landowners on the higher susceptibility of minelands to erosion.</p> <p>Task 2.6.3: Work with mineral extraction companies to implement sediment and compaction reducing BMPs.</p>	<p>Task 2.7.1: Work with farmers and landowners to implement exclusionary fencing practices.</p>
<p><b>Objective 2.5:</b> Reduce / prevent erosion from roads and ditches</p>								<p><b>Objective 2.6:</b> Reduce / prevent erosion from current and past mineral extraction activities.</p>

<p><b>Goal 3:</b> To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of nutrients entering the system.</p>	<p>Task 3.1.1: Implement agricultural BMPs such as cover crops, buffers, filter strips, and nutrient management planning to reduce nutrient losses.</p>
	<p>Task 3.1.2: Work with farmers to strategically restore / construct nutrient-trapping wetlands.</p>
	<p>Task 3.1.3: Work with farmers and commercial applicators to adopt precision agriculture technology to reduce excess applications of nutrients.</p>
	<p>Task 3.1.4: Implement BMPs to improve efficiency of irrigation systems and reduce nutrient losses.</p>
	<p>Task 3.1.5: Increase grower participation in NRCS, DNR, and other conservation programs through strategic marketing.</p>
	<p>Task 3.1.6: Participate in SWCD field days, agricultural customer appreciation days and similar events to highlight environmental and economic benefits of BMP implementation.</p>
	<p>Task 3.2.1: Implement structural BMPs (exclusionary fencing / watering facilities) in pastures with livestock access to surface waters.</p>
	<p>Task 3.2.2: Work with landowners to insure that surface water runoff from feedlots, drylots, or other pasture/holding facilities do not directly enter surface waters.</p>
	<p>Task 3.2.3: Work with farmers to implement manure management/application BMPs</p>
	<p>Task 3.3.1: Work with DNR to promote available help for park and public area managers to eliminate/reduce wildlife (goose) waste runoff..</p>
	<p>Task 3.3.3 Implement buffer strip BMPs on golf courses an parks to eliminate/reduce fertilizer runoff.</p>
	<p>Objective 3.1: Reduce / prevent nutrients from cropping practices from reaching surface water.</p>
	<p>Objective 3.2: Reduce / prevent nutrients from domestic animals and livestock from entering surface water.</p>
	<p>Objective 3.3: Reduce / prevent nutrients from parks and park-like areas from entering surface water.</p>

<p>Task 3.3.4 Work with parks, golf courses, cemeteries and other park-like areas to obtain certification in Audubon International Sanctuary program.</p>	<p>Task 3.4.1: Educate private landowners in methods of lawn / landscaping care that can reduce nutrient inputs.</p> <p>Task 3.4.2: Educate private landowners in how buffers can eliminate / reduce nutrient runoff.</p>	<p>Task 3.5.1: Develop septic system management and design ordinances for local soils conditions, including “alternative” approaches such as composting, incineration, and wetlands systems.</p>	<p>Task 3.5.2: Work with local health department to insure effective inspection of system design and installation.</p>	<p>Task 3.5.3: Work with local banks to insure septic service records and system inspection is a requirement for any home loans.</p>	<p>Task 3.5.4: Educate landowners with septic systems on their proper maintenance.</p>	<p>Task 3.6.1: Work with businesses and landowners to insure that gutters are not connected to stormwater systems.</p>	<p>Task 3.6..2: Install public and private raingardens equal in volume to approximately 1% of roof and parking area runoff.</p>	<p>Task 4.1.1: Reduce and delay runoff from roofs and paved areas through programs that promote installation of BMPs in urban areas.</p> <p>Task 4.1.2: Work with County Officials to reduce development within the floodplain by implementing existing floodplain protection ordinance per FEMA / NFIP requirements.</p>
<p><b>Objective 3.4: Reduce / prevent nutrients from residential yards from entering surface water.</b></p>	<p><b>Objective 3.5: Reduce / prevent nutrients from failing septic systems from entering surface water</b></p>	<p><b>Objective 3.6: Reduce / prevent E. coli from CSOs from entering surface water</b></p>	<p><b>Goal 4:</b> To restore, conserve, and protect the hydrology of the watershed to improve water quality.</p>	<p>Objective 4.1: Perform flood plain management to prevent damaging effects of floods, preserve/enhance natural values, and provide optimal use of land and water resources within the floodplain</p>	<p>Objective 4.1: Perform flood plain management to prevent damaging effects of floods, preserve/enhance natural values, and provide optimal use of land and water resources within the floodplain</p>			

<p><b>Objective 4.2:</b> Limit net increase of impervious surfaces in order to limit runoff and associated with development.</p>	<p>Task 4.2.1: Implement residential / urban BMPs such as rain gardens to offset effects of impervious surfaces.</p> <p>Task 4.3.1: Work with landowners to restore streams to a more naturally vegetated and meandering state and conserve high quality stream habitat.</p> <p>Task 4.3.2: Work with landowners to restore and conserve wetlands and vernal pools.</p> <p>Task 4.3.3: Work with landowners to restore and conserve ephemeral streams and headwaters.</p> <p>Task 4.3.4: Develop and implement a Mitigation Clearinghouse to connect landowners with potential stream, wetland, ephemeral stream, and headwater sites to those in need of mitigation projects.</p> <p>Task 4.3.5: Increase landowner participation in programs such as the Wetlands Reserve Program through strategic marketing.</p>
<p><b>Objective 4.3:</b> Restore and protect the full surface water network, including headwaters, ephemeral streams, and wetlands to positively impact water temperature, add storage capacity and reduce velocity following rain events.</p>	<p>Task 5.1.1: Identify and catalog abandoned mine lands sites.</p> <p>Task 5.1.2: Work with Sycamore Trails RC&amp;D, Indiana DNR Division of Restoration, and Office of Surface Mining programs to restore abandoned mine land sites and prevent pollutants associates with those sites from entering the surface water.</p>
<p><b>Goal 5:</b> To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by preventing or reducing the amounts of metals and sulfates entering the surface water</p>	<p>Task 5.2.1: Develop and implement household waste education programs.</p> <p>Task 5.2.2: Continue and promote efforts for annual collection days of Household Hazardous Waste to prevent them from entering the surface water.</p>

		Task 5.2.3: Reduce and delay runoff from roofs and paved areas through programs that promote installation of BMPs in urban areas.	◆◆◆◆◆
	Objective 6.1: Reduce / eliminate pesticides used in residential applications from reaching surface water.	Task 6.1.1: Continue and promote efforts for annual collection days of Household Hazardous Waste to prevent them from entering the surface water.	◆◆◆◆◆
		Task 6.1.2: Develop educational materials on integrated pest management and safe use of pesticides.	◆◆◆◆◆
	Goal 6: To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by preventing or reducing the amount of pesticides entering the surface water.	Task 6.2.1: Work with park and golf course managers to implement integrated pest management systems.	◆◆◆◆◆
	Objective 6.2: Reduce / eliminate pesticide used in parks and park-like applications from reaching surface water.	Task 6.2.2: Implement buffer strip BMPs on golf courses and parks to reduce pesticide runoff	◆◆◆◆◆
	Objective 6.3: Reduce / eliminate pesticides used in agricultural operations from entering surface water.	Task 6.2.3: Work with parks, golf courses, cemeteries and other park-like areas to obtain certification in Audubon International Sanctuary program.	◆◆◆◆◆
	Goal 7: Restore, conserve, and protect the surface water network to improve overall stream health, hydrology, and wildlife habitat.	Task 6.3.1: Work with agronomists and farmers to adopt integrated pest management systems.	◆◆◆◆◆
	Goal 7.1 Conserve and restore all orders of streams within the watershed to improve overall health of the ecosystem	Task 6.3.2: Work with farmers and commercial applicators to adopt precision agriculture technology to reduce excess applications of pesticides.	◆◆◆◆◆
	Task 7.1.2: Implement BMPs to protect lower order (headwater) streams and seasonal wetlands.	Task 7.1.2: Implement BMPs to protect lower order (headwater) streams and seasonal wetlands.	◆◆◆◆◆
	Task 7.1.3: Develop and implement a Mitigation Clearinghouse to connect landowners with potential stream, wetland, ephemeral stream, and headwater sites to those in need of mitigation projects.	Task 7.1.3: Develop and implement a Mitigation Clearinghouse to connect landowners with potential stream, wetland, ephemeral stream, and headwater sites to those in need of mitigation projects.	◆◆◆◆◆

<p><b>Goal 7.2:</b> Incorporate Green Infrastructure planning techniques throughout the watershed to reduce habitat isolation and improve overall health of the ecosystem.</p>	<p>Objective 8.1: Establish education, outreach, and clean-up programs to reduce in-stream and roadside dumping.</p>	<p>Task 7.2.1: Develop and implement conservation plans that incorporate connectivity between various headwaters, streams, and wetlands.</p> <p>Task 7.2.2: Develop and implement large scale conservation planning that provides connectivity between managed lands.</p>	<p>Task 8.1.1: Develop an outreach and education program to “raise a generation” of non-litterers.</p> <p>Task 8.1.2: Develop an hunter education and outreach about proper disposal of animal carcasses</p>	<p>Task 8.2.1: Work with local officials to impose harsh fines for littering / dumping. (Up to \$1000 by Indiana law)</p> <p>Task 8.2.2: Work with law enforcement and judicial officials to implement in-stream and road-side clean up as part of community service for offenders.</p>	<p>Task 8.2.3: Sponsor amnesty days for tires, electronics, and appliances.</p>	<p>Task 8.2.4: Work with city/township officials to provide trash pick-up as part of utility services.</p> <p>Task 8.2.5: Develop and implement program to provide alternative trash disposal options to area residents.</p>	<p>Task 9.1.1: Develop education materials on the identification and eradication of invasive species.</p> <p>Task 9.1.2: Incorporate invasive species control practices in other workshops – such as forestry and rain garden workshops.</p>	<p>Task 10.1.1: Pre-filter probable sources of pollutants through analysis of georeferenced data.</p>
<p><b>Goal 8:</b> Improve and protect the warmwater fishery and other indigenous aquatic life and wildlife by eliminating the improper disposal of solid waste.</p>	<p>Objective 8.1: Establish education, outreach, and clean-up programs to reduce in-stream and roadside dumping.</p>	<p>Task 9.1.1: Develop education materials on the identification and eradication of invasive species.</p> <p>Task 9.1.2: Incorporate invasive species control practices in other workshops – such as forestry and rain garden workshops.</p>	<p>Task 10.1.1: Improve effectiveness of BMP deployment by refining probable</p>	<p>Goal 9: Prevent the introduction and spread of invasive species through management practices</p>	<p>Goal 10: Further refine critical areas to</p>			

<p><b>effectively implement practices to improve water quality.</b></p> <p><b>sources within <i>current</i> critical areas . .</b></p>	<p>Task 10.1.2: Ground-truth and inventory pollutant sources of pre-filtered drainage areas.</p> <p>Task 10.1.3: Continue to refine, develop and implement sampling modeling strategies to identify sources of pollutants within drainage areas.</p>	<p>Task 10.2.1: Analyze and model data to calculate pollutant loads and sources..</p> <p>Task 10.2.2: Catalog and classify probability of landowner participation and current BMP effectiveness.</p>	<p>Task 11.1.1: Develop a Plan of Work to outline staffing, equipment, financial, and other needs required to further the goals and mission of the BCWP.</p> <p>Task 11.1.2: Develop a financial plan and implement funding strategies to insure the viability of the BCWP.</p>	<p>Task 11.2.1: Scout for and hire appropriate staff in a timely manner.</p>	<p>Task 11.2.2: Develop and maintain a catalog of volunteer's skills, interests, and availability.</p>	<p>Task 11.2.3: Continue to establish and maintain partnerships with other organizations to further their goals and the goals of the BCWP.</p> <p>Task 11.2.4: Maintain the BCWP Technical and Planning Committees to provide input and direction of both work and growth.</p>
	<p>Objective 10.2: Prioritize critical <i>sub-areas</i>, such as stream-reaches for sources of loading and probable/practical implementation of BMPs.</p>	<p>Objective 11.1: Develop appropriate planning to insure the long-term viability and effectiveness of the BCWP.</p>	<p>Goal 11: Build capacities of the BCWP to effectively attain the goals listed above.</p>	<p>Objective 11.2: Provide human and intellectual resources required to further the goals and mission of the BCWP.</p>		

## 7.02 Task Implementation and Indicators

**Goal 1:** To protect and improve water quality within the watershed by preventing E. coli / bacteria from entering the system.

**Objective 1.1:** Reduce / prevent E. coli from failing septic systems from entering surface water

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 1.1.1 Following HUD guidelines for new construction, develop septic system management and design ordinances for local soils conditions, including “alternative” approaches such as composting, incineration, and wetlands systems.	For each County or Township adopting a septic system ordinance, water quality can be expected to maintain or improved through the change in practices outlined by the ordinance.	County Commissioners County Health Office Conservation Districts	0-2 yrs: Evaluate model septic system ordinances with Counties to determine what ordinance language and setbacks would be most acceptable for the County.  2-5 yrs: Work with Counties to alter model ordinance to meet County needs  5-10 yrs: Adopt ordinances	Documented inspections of septic designs and installations. (Administrative)	Cost: \$1,200 - \$1,500 per County or Township to work with a consultant to develop and adopt an ordinance (This estimate assumes minimal oversight and assistance from the consultant)
Task 1.1.2 Work with local health department to insure effective inspection of system design and installation  <i>To be performed in conjunction with Task 1.1.1</i>	Water quality can be expected to maintain or improve through the change in design review and inspection practices	County Board of Health Building Code Officials	0-2 yrs: Develop design evaluation and installation inspection requirements based on Indiana Board of Health requirements.  2-5 yrs: Begin performing interim design reviews and installation inspections.	Number of septic inspections. (Administrative)	Cost: \$1,200 - \$1,500 to work with a consultant to develop and adopt inspection procedures and forms. (This estimate assumes minimal oversight and assistance from the consultant)
Task 1.1.3 Work with local banks to insure septic service records and system inspection is a requirement for any home loans.	Water quality can be expected to maintain or improve by requiring proper septic inspection to qualify for home loans.	Banks / Loan Officers County Recorders Realtors Appraisers	0-1 yrs: Develop web page with downloadable fact sheets. Develop form to be file with Board of Health and Buyer.  1-2 yrs: Launch awareness campaign, especially for real estate professionals.  By year 3, 50% of all real estate transfers done with septic inspection. By year 5: All real estate transfers done with septic inspection	Number of septic inspections. (Administrative)	Cost: \$1,200 - \$1,500 to work with a consultant to develop and adopt inspection procedures and forms. (This estimate assumes minimal oversight and assistance from the consultant)

Task 1.1.4 Educate landowners with septic systems on their proper maintenance	It can be expected that landowners who read the media articles will become more informed as to how their management practices can impact water quality.  Some of these landowners can be expected to change their practices and this will improve or maintain water quality	Local Septic Professionals County Board of Health Conservation Districts.	0-1 yrs: Develop web page with downloadable factsheets.  1-2 yrs: Write articles for media.  Year 2: Host workshop. Obtain discounts from local septic care professionals as attendee take-aways.	Number of attendees at (Administrative)	Cost: <\$1,000
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**Load Reductions** (based upon the Watershed Treatment Model from the Center for Watershed Protection):

- *Failing Private Septic*  
A decrease from an estimated 75% failure rate to 50%, should result in a decrease in fecal coliforms attributed to those systems by 20% - from 18 billion cfu / year to 14.5 billion cfu / year.

**Goal 1:** To protect and improve water quality within the watershed by preventing E. coli / bacteria from entering the system.

**Objective 1.2:** Reduce / prevent E. coli from CSOs from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 1.2.1 Work with businesses and landowners to insure that gutters are not connected to stormwater systems	CSOs are currently a substantial source of E. coli in the Buck Creek area. Any and all reductions of stormwater flow through the sewer system will positively impact water quality	Town Councils  City and County Sewage Treatment Facilities	0-2 yrs: Review of previous disconnect campaigns.  Awareness campaign, including stormwater webpage and 'news release' /article to local media.	Completion of on-foot survey. (Administrative)  CF of water entering wastewater treatment facilities (Administrative)	Cost: <\$1,000
Task 1.2.2 Install public and private raingardens equal in volume to approximately 1% of roof and parking area runoff	CSOs are currently a substantial source of E. coli. Any and all reductions of stormwater flow through the sewer system will positively impact water quality.	SWCDs  Sullivan County Park & Lake  Parks Departments  Garden Clubs  Garden Centers	2-5 yrs: On-foot survey of structures  0-2 yrs: Awareness campaign, including raingarden webpage and factsheet / flyer.	Number of attendees at workshop. (Administrative)  Estimated number of garden center clientele installing rain gardens. (Social)  Year 5: Host 2 <sup>nd</sup> raingarden workshop / install raingarden at public facility.	Cost: Flyers and webpage: <\$1,000  Workshop: <\$500  Demo Raingarden \$2500 - \$3750 ea (\$10-15 / sf)  Cubic Feet (CF) of water entering wastewater treatment facilities. (Administrative)

**Load Reductions** (based upon the Watershed Treatment Model from the Center for Watershed Protection)

- **Combined Sewer Overflow**
  - A decrease from an estimated 40% urban impervious areas to 35%, should result in a decrease in fecal coliforms attributed to those CSOs by 1% - from 75.8 quadrillion cfu / year to 75.2 quadrillion cfu / year.

**Goal 1:** To protect and improve water quality within the watershed by preventing E. coli / bacteria from entering the system.

**Objective 1.3:** Work with farmers and landowners to eliminate livestock impact on streams and ponds/lakes connected to streams.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 1.3.1 Implement structural BMPs (exclusionary fencing / watering facilities) in pastures with livestock access to surface waters.  Where applicable, enroll sites into wetland/stream restoration programs.	Reduce break down of streambanks, disturbance of streambeds, and entrance of animal wastes in surface waters.	SWCDs NRCS Regulatory Agencies Mitigation Partners	0-3 yrs: Strategically market program to producers and landowners. Develop site- specific conservation plans. Enroll sites into mitigation clearinghouse.  2-4 yrs: Install exclusionary fencing, stream crossings & watering facilities as required.  2-5 yrs: Develop engineering plans and secure necessary permits as required.  4-10 yrs: Stream restoration activities	Document number of sites completed / if of stream restored. (Administrative)  Before & After photographs (Administrative)  Habitat evaluation (Environmental)  Water sampling (turbidity, e.coli, D.O., phosphorus, TSS). (Environmental)	Cost: Mitigation Clearinghouse: \$5000 / year  Fencing: \$2500 - \$3500 / site (2000 ft)  Stream Crossing: \$3000 - 4000 / site (1 ea)  Watering Facility: \$1200 - 2000 / site (2 ea)  Engineering / Permitting: \$5000 – 10,000 / site (1000 ft)  Restoration: \$20,000 – 35,000 / site (1000 ft)
Task 1.3.2 Work with landowners to insure that surface water runoff from feedlots, drylots, or other pasture/holding facilities do not directly enter surface waters.  <i>To be implemented in conjunction with Task 1.3.3</i>	Reduced entry of surface soil and animal wastes into surface waters.  Improved forage quality.	SWCDs NRCS Feed Mills Veterinarians 4-H Clubs Horse & Pony Clubs	0-3 yrs: Strategically market program to producers and landowners. Develop site- specific Conservation Plans.  2-5 yrs: Install filter strips and/or buffers. Install fencing as needed. Implement intensive and/or rotational grazing strategies.	Document number of sites completed, acres of buffers and/or filter strips installed, if of fencing (electric or similar) (Administrative)  Before & After photographs (Administrative)  Habitat evaluation (Environmental)	Cost: Buffers & Filter Strips: \$150 / Ac  Fencing: \$750 - \$1000 / site (500 ft)  Sources: 319 funds, NRCS Programs.
				Water sampling (turbidity, e.coli, D.O., phosphorus, TSS). (Environmental)	

Task 1.3.3 Work with farmers to implement manure management / application BMPs	Reduced entry of animal wastes into surface waters. Reduced P concentrations in areas of manure application.	SWCDs NRCS Agronomists	0-3 yrs: Strategically market program to effected producers and landowners. Develop & implement comprehensive nutrient management plans.	Document number of comprehensive nutrient management plans developed. (Administrative)	Cost: Comprehensive Nutrient Management Plan: \$1000 ea
				Document number of complementary BMPs implemented (soil sampling, storage areas) (Administrative)	Sources: 319 funds, NRCS programs

**Load Reductions (based upon PReditCT model from the University of Pennsylvania and the Watershed Treatment Model from the Center for Watershed Protection):**

- *Exclusionary Fencing / Watering Facilities*  
160,000 cfu / 100 Ac pasture exclusion / year
- *Feedlot Waste Storage / Management*  
If estimated waste exposed to run-off is cut in half, fecal coliforms attributed to feedlots should decrease by approximately 396,000 billion cfu / year.
- *Manure Management / Application BMPs*  
If estimated waste is applied in such a way as to prevent 85% of run-off from reaching surface waters, fecal coliforms attributed to manure applications can decrease by 632,000 billion cfu / year.

**Goal 1:** To protect and improve water quality within the watershed by preventing E. coli / bacteria from entering the system.

**Objective 1.4:** Reduce/prevent E.coli from parks and park-like areas from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 1.4.1 Work with DNR to promote available help for park and public area managers to eliminate/reduce wildlife (goose) waste runoff	<ul style="list-style-type: none"> <li>Provide "how-to" documents &amp; strategies in dealing with wildlife (goose) problems.</li> <li>Reduce amount of animal (goose) waste entering surface waters.</li> <li>Reduce impacts of wildlife (goose) population on park use and quality.</li> </ul>	<ul style="list-style-type: none"> <li>DNR – Division of Fish &amp; Wildlife</li> <li>Park Managers &amp; Boards</li> </ul>	<ul style="list-style-type: none"> <li>0-2 yrs: Develop web page specific to wildlife (goose) management.</li> <li>Launch awareness campaign that goose management assistance is available through DNR.</li> </ul>	<ul style="list-style-type: none"> <li>Web page (Administrative)</li> <li># on-site training sessions. (Administrative)</li> <li>Reduction of goose populations. (Administrative)</li> </ul>	<ul style="list-style-type: none"> <li>Web Page: &lt;\$1000</li> <li>Training Sessions: \$500-1000 ea</li> <li>Sources: DNR, 319 funds</li> </ul>
Task 1.4.2 Work with and distribute information to landowners to help them adopt management techniques to help reduce/eliminate wildlife (goose) waste runoff.	<ul style="list-style-type: none"> <li>Reduce amount of animal (goose) waste entering surface waters.</li> <li>Reduce impacts of wildlife (goose) population on private ponds and lakes, including Conservancy District lakes.</li> </ul>	<ul style="list-style-type: none"> <li>DNR – Division of Fish &amp; Wildlife</li> <li>Park Managers &amp; Boards</li> <li>SWCDs</li> </ul>	<ul style="list-style-type: none"> <li>0-2 yrs: See Task 1.4.1</li> <li>Year 3: Launch awareness campaign. Provide "news release" / article to local media.</li> </ul>	<ul style="list-style-type: none"> <li>Distribution of Factsheet and/or guidelines. (Social)</li> <li>Web page. (Administrative)</li> <li>Requests for additional information. (Social)</li> </ul>	<ul style="list-style-type: none"> <li>Printing: \$500</li> <li>Web page: &lt;\$1000</li> <li>Sources: DNR, 319 funds, Conservancy District</li> </ul>

**Load Reductions** (based upon PReditCT model from the University of Pennsylvania and the Watershed Treatment Model from the Center for Watershed Protection):

- For every 100 geese controlled (waste eliminated from direct deposition or runoff), E. coli loads should decrease by approximately 3,000 billion colonies / year. Note: loads were calculated based upon 3lb feces / day / bird.

**Goal 2:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.

**Objective 2.1:** Identify and stabilize priority bank erosion sites through the installation of corrective measures.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 2.1.1 Implement BMPs to reduce the amount of sediment entering surface waters.  Where applicable, enroll sites into wetland/stream restoration programs.	Reduced sedimentation and turbidity resulting from stream bank erosion and collapse.  Improved riparian corridors.  Improved stream health.  Improved wildlife habitat.	SWCDs NRCS Conservation District Regulatory Agencies Mitigation Partners Conservancy District	0-15 yrs: Strategically market program to affected producers and landowners. Develop site specific conservation plans. Enroll sites into mitigation clearinghouse.  2-15 yrs: Develop engineering plans and secure necessary permits as required.  4-15 yrs: Streambank stabilization and restoration activities	Document number of sites completed and/or lf of stream restored. (Administrative)  Before & After photographs (Administrative)  Habitat evaluations (Environmental)  Water sampling (turbidity, TSS). (Environmental)	Costs: Mitigation Clearinghouse: \$5000 / year  Engineering / Permitting: \$5000 – 10,000 / site (1000 lf)  Restoration: \$20,000 – 35,000 / site (1000 lf)  Sources: 319 Funds, NRCS Programs, DNR Programs, Govt Agencies & Private Parties in need of Mitigation
Task 2.1.2 Target riparian landowners with information about shoreline protection	Enrollment of sites into mitigation clearinghouse.  Reduced sedimentation and turbidity resulting from stream bank erosion and collapse.  Improved riparian corridors.  Improved stream health.  Improved wildlife habitat	SWCDs NRCS Conservation District Regulatory Agencies Mitigation Partners	0-1 yr: Develop webpage specific to riparian area conservation. Highlight incentive programs, shoreline management techniques, mitigation clearinghouse. Provide "news release"/ article to local media. Host Mitigation Clearinghouse public meeting. Enroll at least 10 sites in mitigation clearinghouse  2-5 yrs: Contact riparian area landowners. Enroll at least 20 sites in mitigation clearinghouse. Match at least 5 sites with mitigation partners.	Document number of sites completed and lf of stream restored. (Administrative)  Before & After photographs (Administrative)  Habitat evaluations (Environmental)  Waer sampling (turbidity, TSS). (Environmental)	Costs: Mitigation Clearinghouse: \$5000 / year  Web page / fact sheets: <\$1000  Workshop: \$500-1000  Sources: 319 Funds, NRCS Programs, DNR Programs, Govt Agencies & Private Parties in need of Mitigation

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construction technical  
assistance for at least 15  
sites / year.

**Load Reductions** (based upon STEP-L and PRédict models):

- *Bank Stabilization*  
For moderately degraded streambank (4 ft deep, losing 0.06-0.2 feet / year): 73 T / mile streambank / year
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**Goal 2:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.

**Objective 2.2:** Reduce impacts of stormwater runoff on bank erosion.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 2.2.1 Work with landowners to restore streams to a more natural, meandering state to add storage capacity and slow velocity.  <i>See Task 2.1.1</i>	Reduced scouring and streambank erosion from volume & velocity of peak flows.  Reduced sedimentation and turbidity resulting from stream bank erosion and collapse.  Improved riparian corridors.  Improved stream health.  Improved wildlife habitat	See Task 2.1.1	See Task 2.1.1	Document number of sites completed and acres of wetlands restored.  <i>(Administrative)</i>	Costs: Mitigation Clearinghouse: \$5000/yr/year
Task 2.2.2 Work with landowners and municipalities to restore or construct wetlands to add storage capacity and slow velocity of runoff	Reduced scouring and streambank erosion from volume & velocity of peak flows.  Reduced sedimentation and turbidity resulting from stream bank erosion and collapse.  Improved riparian corridors.  Improved stream health.  Improved wildlife habitat	SWCDS NRCS Local Government Officials Conservation District Regulatory Agencies Mitigation Partners	0-3 yrs: Strategically market program to govt officials and landowners. Develop site-specific conservation plans. Enroll sites into mitigation clearinghouse.  2-15 yrs: Develop engineering plans and secure permits as required.  4-15 yrs: Wetland restoration and construction activities.	Before & After photographs  <i>(Administrative)</i>  Habitat evaluations  <i>(Environmental)</i>  Water sampling (turbidity, TSS).  <i>(Environmental)</i>  Observations of peak flow volumes & duration  <i>(Environmental)</i>	Engineering / Permitting (emergent wetlands): \$2500 - \$3500 / ac Engineering / Permitting (woodyed wetlands); \$4000 - \$5000 / ac  Restoration (initial): \$3000 – 5000 / ac Restoration (maintenance through establishment): \$1500 - \$3500 / ac  Sources: 319 Funds, NRCS Programs, DNR Programs, Govt Agencies & Private Parties in need of Mitigation

<b>Task 2.2.3</b> Implement agricultural BMPs to increase infiltration rate of precipitation.	Reduced scouring and streambank erosion from volume & velocity of peak flows.  Reduced sedimentation and turbidity resulting from stream bank erosion.  Reduced surface run-off.  Reduced sedimentation from farm fields.  Reduced pollutants associated with soil erosion entering streams.  Improved stream health.  Improved wildlife habitat	SWCDs NRCS Agronomists Ag-Suppliers	0-3 yrs: Strategically market program to producers. Develop site-specific conservation plans. Enroll at least 3 new producers / year into NRCS or BCWP programs.  3-5 yrs: Continue marketing and conservation plan development. Enroll at least 5 new producers / year into NRCS or BCWP programs.  5-15 yrs: Continue marketing and conservation plan development.	Documented number of growers enrolled in programs. (Social)	Documented acreage on which BMPs / Conservation Plans have been implemented. (Administrative)	Documentation of turbidity, sediment, flow volume and velocity. (Environmental)	No-Till Conversion: \$20/ac  Conservation Crop Rotation: \$50/ac	Cover Crops: \$50-80 / ac  Contour Farming: \$12 / ac	Field Borders: 50¢ / ft (\$15/ac conservation cover)  Windbreak/Shelterbelt Establishment: \$1 / ft	Sediment Basin: \$9000-10,000 ea  Terrace: \$8-10 / ft	WASCOB: \$2500-3000 ea  Sources: 319 Funds, NRCS Programs, DNR Programs, American Farmland Trust, Conservation Organizations (QU, DU, DWF, NWT), Govt Agencies & Private Parties in need of Mitigation	See Task 1.2.2
<b>Task 2.2.4</b> Implement residential / urban BMPs such as rain gardens and rain barrels to increase infiltration rate of precipitation	Reduced scouring and streambank erosion from volume & velocity of peak flows.  Reduced sedimentation and turbidity resulting from stream	See Task 1.2.2	See Task 1.2.2									

- bank erosion.
  - Reduced surface run-off.
  - Reduced pollutants associated with urban run-off entering streams.
  - Improved stream health.
  - Improved wildlife habitat

**Load Reductions (based upon STEP-L and PRDICT models):**

- *Bank Stabilization*
  - For moderately degraded streambank (4 ft deep, losing 0.06-0.2 feet / year): 73 T / mile streambank / year
- *Wetland Restoration*
  - Wetland effectiveness depends upon drainage area land uses, conditions, and wetland design. The following figures do not take into account reduction of downstream stream bank erosion.
  - Urban: 7.2 T / 100 Ac / year
  - Agriculture: 370 T / 100 Ac / year
  - Pastureland: 1760 lb / 100 Ac / year
- *Agricultural BMPs*
  - Agricultural BMP effectiveness depends land conditions, including soil type, slope, and past management systems.
  - Cover Crops / Crop Rotation: 163 T / 100 Ac / year
  - Conservation Tillage: 300 T / 100 Ac / year
  - Contour Farming: 192 T / 100 Ac / year
  - Terraces and Diversions: 333 T / 100 Ac / year
  - Vegetative Buffers: 272 T / 100 Ac / year
- *Rain Gardens*
  - Effectiveness of rain gardens have minimal direct impacts on sedimentation. Their primary effect on erosion is the slowing of water to prevent channel and streambank erosion. A decrease in imperviousness from 40% to 35% in urban areas should yield a 46 T / year reduction in sediments.

**Goal 2:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.

**Objective 2.3:** Prevent / reduce erosion from farm fields.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 2.3.1 Implement agricultural BMPs to reduce surface water runoff and resulting soil erosion.	Reduced surface run-off. Reduced sedimentation from farm fields.  Reduced pollutants associated with soil erosion entering streams.  Improved stream health.	See Task 2.2.3	See Task 2.2.3	See Task 2.2.3	See Task 2.2.3
Task 2.3.2 Work with landowners to strategically restore or construct wetlands to trap sediments.  Where applicable, enroll sites into wetland/stream restoration programs	Improved wildlife habitat  Reduced scouring and streambank erosion from volume & velocity of peak flows.  Reduced nutrients and sediments entering streams. Improved riparian corridors.  Improved stream health.	SWCDs NRCS Conservancy District Ditch Board Regulatory Agencies Mitigation Partners	See Task 2.2.2	See Task 2.2.2	See Task 2.2.2
Task 2.3.3 Work with landowners to restore riparian areas, including tertiary streams  Where applicable, enroll sites into wetland/stream restoration programs	Improved wildlife habitat  Reduced scouring and streambank erosion from volume & velocity of peak flows.  Reduced nutrients, sediments, and other pollutants entering streams. Improved riparian corridors.  Improved stream health.	SWCDs NRCS Conservancy District Ditch Boards Regulatory Agencies Mitigation Partners	See Task 2.2.1	See Task 2.2.1	See Task 2.2.1
Task 2.3.4 Implement BMPs to improve	Reduced surface run-off.	SWCDs	0-3 yrs: Strategically market program to producers.	Documented number of systems and acreage on	Costs: Irrigation Water Management

efficiency of irrigation systems in order to reduce surface water and resulting soil erosion	Reduced sedimentation from farm fields. Reduced pollutants associated with soil erosion entering streams. Reduced sub-surface drainage entering streams  Reduced pollutants associated with sub-surface agricultural drainage entering streams.  Improved stream health.	NRCS Agronomists Irrigation Dealers	Perform uniformity test and flow monitoring on enrolled systems. Develop & Implement irrigation water management plans on enrolled systems. Enroll at least 5 producers into program.  3-15 yrs: Continue marketing and conservation plan development. Enroll at least 2 new producers / year into program.	which Irrigation Water Management Plans and BMPs have been implemented. (Administrative)	Irrigation Water Management Implementation: \$8.00 / ac	Plan: \$500 ea
Task 2.3.5 Increase grower participation in NRCS, DNR, and other conservation programs through strategic marketing.	The number of growers and/or agricultural acreage enrolled in conservation programs is directly related to reductions of agriculture-related pollutants entering surface water.	SWCDs NRCS Agronomists Ag Suppliers	0-3 yrs: Work with agronomists and ag suppliers to strategically market program to producers. Take applications from at least 5 new producers / year into program.	Documented number of growers enrolled in programs (Social)	Costs: Staff: \$40,000 / yr Sources: SWCDs, Partnership for Turtle Creek	Costs: Staff: \$40,000 / yr Sources: SWCDs, Partnership for Turtle Creek
Task 2.3.6 Participate in SWCD field days, agricultural customer appreciation days, and other similar events to highlight environmental and economic benefits of BMP implementation	Demonstrating environmental and economic benefits can help increase the number of growers and/or agricultural acreage enrolled in conservation programs. See Task 2.3.5  Demonstrating economic benefits can directly impact SCWD funding at county levels.	SWCDs NRCS Agronomists Ag Suppliers	0-2 yrs: Develop catalog of all area SWCD field days and ag customer appreciation days. Review and/or revise annually. BCWP rep to give presentations at field day for each participating SWCD.  2-15 yrs: Give presentation on programs or have information booth at 20% of events each year. (Rotating to hit each event at least once every five years)	Documented number of events and attendees. (Administrative)	Costs: Labor & Travel: \$4000-6000 / yr Sources: 319 funds, SWCDs, Clean Water Indiana	Costs: Labor & Travel: \$4000-6000 / yr Sources: 319 funds, SWCDs, Clean Water Indiana

### **Load Reductions (based upon STEP-L and PRDICT models):**

- *Agricultural BMPs*
  - Agricultural BMP effectiveness depends land conditions, including soil type, slope, and past management systems.
  - Cover Crops / Crop Rotation: 163 T / 100 Ac / year
  - Conservation Tillage: 300 T / 100 Ac / year
  - Contour Farming: 192 T / 100 Ac / year
  - Terraces and Diversions: 333 T / 100 Ac / year
  - Vegetative Buffers: 272 T / 100 Ac / year
- *Wetland Restoration*
  - Wetland effectiveness depends upon drainage area land uses, conditions, and wetland design. The following figures do not take into account reduction of downstream stream bank erosion.
  - Agriculture: 370 T / 100 Ac / year
  - Pastureland: 1760 lb / 100 Ac / year
- *Bank Stabilization*
  - For moderately degraded streambank (4 ft deep, losing 0.06-0.2 feet / year): 73 T / mile streambank / year
- *Irrigation*
  - Improved Water Management
    - Although studies indicate reduction of sediments through irrigation scheduling and efficiency, none have indicated potential reduction figures.  
At an efficiency similar to half that of conservation tillage: 148 T / 100 Ac / year
    - Tailwater Reuse / Sediment Retention Basins: 300 T / 100 Ac / year
    - Farming “In the Round”
      - By farming in patterns mimicking center pivot tracks, run-off can be mostly confined to the irrigated area. Studies indicate this to be a well-known practice that is widely adopted in the Western U.S., but potential reduction figures are lacking.  
At an efficiency similar to half that of conservation tillage: 148 T / 100 Ac / year

**Goal 2:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.

**Objective 2.4:** Prevent / reduce erosion resulting from logging / land clearing activities.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 2.4.1 Host forestry workshops to demonstrate environmental and economic benefits of properly planned and conducted logging activities	Reduced turbidity. Reduced water temperature. Improved health of riparian communities. Increase economic gains through timber management and sales.	DNR – Division of Forestry Sycamore Trails RC&D Forestry Committee Certified Foresters	0-1 yrs: Work with RC&D committee to schedule and host workshops. 1-2 yrs: Develop web page with downloadable fact sheets. Launch media campaigns for workshops. 2-15 yrs: Review / revise workshop topics, locations, etc.	Documented number attendees at workshops. (Administrative) Reduced or less invasive logging activities, especially near surface waters. (Environmental)	Costs: Workshop: \$1000 ea Sources: 319 funds, DNR, Sycamore Trails
Task 2.4.2 Work with DNR in development / promotion of certified forester assistance program to help landowners develop logging plans	Reduced turbidity. Reduced water temperature. Improved health of riparian communities. Increase economic gains through timber management and sales.	DNR – Division of Forestry Sycamore Trails RC&D Forestry Committee Society of American Foresters Certified Foresters	0-1 yrs: Develop contact list of regional certified foresters. 1-2 yrs: Launch awareness campaign, including web page and fact sheets. 2-15 yrs: Target forested area landowners to participate in program.	Number of classified forests. (Administrative) Number of logging plans developed. (Administrative)	FWS

**Load Reductions:**

Studies indicate that proper harvest planning and forestry BMP implementation result in little impact to water quality. Forestry BMPs are less about load reduction than *load prevention*.

- *Conversion to Ag Lands*  
Based upon conversion from agricultural to forested land use (92% efficiency), 425 T / 100 Ac / year *prevented* for lands kept in timber
- *Clearing of Riparian Areas*  
Based upon stabilization of stream banks (95% efficiency), 125 T / mile streambank / year *prevented* for riparian areas kept in timber

**Goal 2:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.

**Objective 2.5:** Reduce / prevent erosion from roads and ditches.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 2.5.1 <i>Work with Sullivan County officials to clarify road and utility easements for construction and maintenance of county roads.</i> <i>To be implemented concurrently with Task 2.5.2</i>	Clear definitions of road and ditch right-of-ways will allow appropriate space for construction and maintenance of county roads.  Clearly defined right-of-ways will reduce encroachment of landowners into ditches, reducing ditch erosion, sedimentation, and collapse.	County Attorney, Commissioners, and Council Conservancy District Drainage Board Utility companies with roadside ROWs.	0-1 yrs: Review existing road utility, and drainage board easements. Review applicability of Indiana State legislation.  2-5 yrs: Develop and implement county-wide road/ditch ROW.	Adoption of county-wide road/ditch RCW. (Administrative)	Buffers: \$150 / Ac
Task 2.5.2 <i>Work with County Officials to develop and implement road and ditch protection guidelines.</i> <i>To be implemented concurrently with Task 2.5.1</i>	Clearly defined road and ditch protection ordinances will reduce encroachment of landowners into ditches, reducing ditch erosion, sedimentation, and collapse.	County Attorney, Commissioners, and Council Conservancy District Drainage Board Utility companies with roadside ROWs.	0-1 yr: Evaluate model road & ditch protection ordinances with County Commissioners & County Attorney. Develop road & ditch buffer guidelines.  2 yr: Adopt guidelines. Provide road & ditch buffer guidelines to landowners.  3-5 yrs: Implementation of buffers. Enforcement of ordinance.	Adoption of road/ditch protection guidelines. (Administrative)  LF of ditch buffer installation (Administrative)	Demonstration Projects: \$30,000 (\$7500 match) New Ditches: \$25 / lf (\$32,000 / mi) Buffers: 50¢ / lf (\$2600 / mi; Conservation Cover \$150/ac)
Task 2.5.3 <i>Work with DNR and County Department of Transportation to develop and implement low-cost, low-maintenance ditching solutions.</i> <i>To be implemented concurrently with Task 2.5.2</i>	Reduced ditch and stream sedimentation.  Reduced road and ditch maintenance costs.	DNR – LARE Program. County Dept. of Transportation SWCDs SCPL Shakamak Park	0-1 yr: Apply for DNR LARE program assistance.  Year 2: Ditch design by DNR or consultant. Install 2-4 demonstration projects and train Department of Transportation personnel.  3-5 yrs: Install 1-2 mi approved ditches ea year. Install 2-3 mi field borders and buffers ea year.	Approved ditch design (Administrative)  Mi / LF of approved ditch installations (Administrative)  Maintenance savings (Administrative)	Cost Savings: Buffers: \$12,500 / year ditch maintenance.

	approved ditches ea year. Install 2-3 mi field borders and buffers ea year. Maintain 1-2 mi approved ditches ea year.	County Engineers County Commissioners County Departments of Transportation Reduced maintenance costs.	0-1 yr: Develop guidelines based on PA Center for Dirt & Gravel Roads, Bay State Roads Program.  Year 2: Implement improved materials and methods at ditch demo sites See Task 2.5.3	Adoption of improved road construction materials & methods guidelines. (Administrative)	Costs: Difference between pit run and crusher run gravel.  Crew Training: part of initial design installation.
Task 2.5.4 Work with County Commissioners and Departments of Transportation to transition to improved road construction materials & methods  <i>To be implemented concurrently with Task 2.5.3</i>	Reduction of aggregate loss (Ave. loss of 1" /yr = 20T/mi)  Reduced sedimentation of ditches and streams.  Reduced maintenance costs.	Surface Mines (re design / road settling)	3-5 yrs: Install 1-2 mi improved gravel roads in conjunction with ditch improvements. See Task 2.5.3  5-15 yrs: Install 1-2 mi improved gravel roads in conjunction with ditch improvements. See Task 2.5.3.	Mi / LF of improved road installations. (Administrative)  Maintenance savings (Administrative)	Sources: County Highway Funds, 319 funds, DNR, Clean Water Indiana

**Load Reductions:** Based upon studies by the Pennsylvania Center for Dirt and Gravel Roads on sediment losses (these figures do not include generation of dust or loss of gravel):

- *Buffer Zones*  
15 T / ditch mile / year
- *Improved Ditch Design*  
37 T / ditch mile / year
- *Improved Driving Surface Aggregates*  
220 lbs / road mile / year
- *Raised Road Elevations*  
560 lbs / road mile / year
- *Gradebreaks*  
150 lbs / road mile / year
- *Additional Drainage Outlets*  
144 lbs / road mile / year
- *Berm Removal (Shoulder Regrade)*  
177 lbs / road mile / year

**Goal 2:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.

**Objective 2.6:** Reduce / prevent erosion from current and past mineral extraction activities.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 2.6.1 Work with coal mines to enroll farmlands under mine control into conservation programs.	The number of growers and/or agricultural acreage enrolled in conservation programs is directly related to reductions of agriculture-related pollutants entering surface water.	Coal Companies SWCDs NRCS	0-1 yrs: Meet with coal mine land managers to explain control requirements of conservation programs  0-2 yrs: Work with coal mines to increase lease terms to 3-5 year  5 yr: Review / update based upon program requirements (5 year cycle)	Number of leases modified to allow enrollment into conservation programs. (Social)	Cost: Labor <\$500  Sources: SWCD, NRCS
Task 2.6.2 Launch outreach campaign to educate farmers and landowners on the higher susceptibility of minelands to erosion	Reduced removal of reclamation practices. Maintain or improve water quality.	Coal Companies SWCDs NRCS	0-2 yrs: Promote use of <i>Farm Management Practices for Reclaimed Farmlands</i> . Develop list of tracts due to be released from bonds. Target already-released lands for conservation program enrollment.  2-15 yrs: Call on and distribute information packet to farmers and landowners of reclaimed minelands. Perform windshield survey of reclaimed minelands on annual basis to determine levels of conservation needed.	Before and after photos. (Administrative)  Enrollment of reclaimed lands into conservation programs. (Administrative)	Cost: Information Packet: \$1000  Surveys & Calls: \$3000-4000 / year  Sources: 319 funds, SWCDs

Task 2.6.3 Work with mineral extraction companies to implement sediment and compaction reducing BMPs.	Reduced compaction on Oil & Gas Well sites. Reduced soil erosion during soil & gas well installation Reduced sedimentation from pre-mining and reclamation activities	Mineral Companies DNR – Division of Reclamation DNR – Division of Oil & Gas Wells Permitting / Regulatory Agencies	0-3yrs: Secure assurance from permitting / regulatory agencies that improved techniques will not affect existing permits. Work with Oil & Gas companies to implement BMPs used on traditional construction sites.  3-5 yrs: Continue to implement BMPs on Oil / Gas Wells. Develop BMPs to implement on pre/post mine lands.  5-15yrs: Implement BMPs on mine lands	Agreements with regulatory agencies. (Administrative)  BMP guidelines. (Administrative)	Costs: Labor: \$30000-50000  Sources: 3:19 funds, Private Investment
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#### Load Reductions (based upon STEP-L and PReditCT models):

- *Agricultural BMPs (as apply to reclaimed mine lands)*  
Agricultural BMP effectiveness depends land conditions, including soil type, slope, and tract management systems.
  - Cover Crops / Crop Rotation: 163 T / 100 Ac / year
  - Conservation Tillage: 300 T / 100 Ac / year
  - Contour Farming: 192 T / 100 Ac / year
  - Vegetative Buffers: 272 T / 100 Ac / year

**Goal 2:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of sediment entering the system.

**Objective 2.7:** Work with farmers and landowners to eliminate livestock access to creeks, streams, and ponds/lakes connected to them.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 2.7.1: Work with farmers and landowners to implement exclusionary fencing programs.  Where applicable, enroll sites into wetland/stream restoration programs.  See Task 1.3.1	See Task 1.3.1	See Task 1.3.1	See Task 1.3.1	See Task 1.3.1	See Task 1.3.1

**Load Reductions** (based upon STEP-L and PRDICT models):

- *Exclusionary Fencing / Watering Facilities*
  - For severely degraded streambank (4 ft deep, losing 0.3-0.5 feet / year): 215 T / mile streambank / year
- *Bank Stabilization*
  - For severely degraded streambank (4 ft deep, losing 0.3-0.5 feet / year): 280 T / mile streambank / year
- *Wetland Restoration*
  - Wetland effectiveness depends upon drainage area land uses, conditions, and wetland design. The following figures do not take into account reduction of downstream stream bank erosion.
    - Agriculture: 370 T / 100 Ac / year
    - Pastureland: 1760 lb / 100 Ac / year

**Goal 3:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of nutrients entering the system.

**Objective 3.1:** Reduce / prevent nutrients from cropping practices from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 3.1.1 Implement agricultural BMPs to reduce nutrient losses.  See Task 2.2.3	Reduced surface run-off Reduced pollutants associated with soil erosion, leaching, or application overwash entering streams.  Improved stream health.  Improved wildlife habitat.	SWCDs NRCS Agronomists Ag-Suppliers	See Task 2.2.3	See Tasks 2.2.3, 2.2.2	See Task 2.2.3 <i>In addition to those costs listed:</i> Comprehensive Nutrient Management Plan: \$1000  Nutrient Management: \$20 / Ac
Task 3.1.2 Work with farmers to strategically restore / construct nutrient-trapping wetlands.  Where applicable, enroll sites into wetland/stream restoration programs.  See Tasks 2.3.1, 2.2.3, 2.2.2	Reduced surface run-off Reduced pollutants associated with soil erosion, leaching, or application overwash entering streams.  Improved stream health.  Improved wildlife habitat.	SWCDs NRCS Conservancy District Regulatory Agencies Mitigation Partners	See Tasks 2.3.1, 2.2.3, 2.2.2	See Tasks 2.3.1, 2.2.3, 2.2.2	See Tasks 2.3.1, 2.2.3, 2.2.2
Task 3.1.3 Work with farmers and commercial applicators to adopt precision agriculture technology to reduce excess applications of nutrients	Reduced pollutants associated with application overlap.	SWCDs NRCS Agronomists Ag-Suppliers	0-2 yrs: Market Precision Ag as tiered cost-share. (Based upon other BMP adoptions). Host P.A. training.  2-15 yrs: Review new P.A. technology on annual basis. Develop adoption / cost share guidelines on new technology. Continue hosting P.A. training on annual basis.	Costs:  Lightbar: \$1500-5000 ea system Basic system required for other PA apps: \$7,000-\$11,000 ea system  Autosteer app: \$9000-\$12,000 ea system Autoswath app: \$9000 - \$15,000 ea system	

Task 3.1.4 Implement BMPs to improve efficiency of irrigation systems and reduce nutrient losses through surface run-off and leaching  See Task 2.3.4	Reduced surface run-off.  Reduced pollutants associated with soil erosion entering streams.  Reduced pollutants associated with sub-surface agricultural drainage entering streams.  Improved stream health.	See Task 2.3.4  See Task 2.3.4  See Task 2.3.4			
Task 3.1.5 Increase grower participation in NRCS, DNR, and other conservation programs through strategic marketing.  See Task 2.3.5	See Task 2.3.5  See Task 2.3.5  See Task 2.3.5	See Task 2.3.5  See Task 2.3.5  See Task 2.3.5	See Task 2.3.5  See Task 2.3.5  See Task 2.3.5	See Task 2.3.5  See Task 2.3.5  See Task 2.3.5	See Task 2.3.5  See Task 2.3.5  See Task 2.3.5
Task 3.1.6 Participate in SWCD field days, agricultural customer appreciation days, and other similar events to highlight environmental and economic benefits of BMP implementation  See Task 2.3.6	See Task 2.3.6  See Task 2.3.6  See Task 2.3.6	See Task 2.3.6  See Task 2.3.6  See Task 2.3.6	See Task 2.3.6  See Task 2.3.6  See Task 2.3.6	See Task 2.3.6  See Task 2.3.6  See Task 2.3.6	See Task 2.3.6  See Task 2.3.6  See Task 2.3.6

#### Load Reductions (based upon STEP-L and PRDICT models):

- *Agricultural BMPs*
  - Agricultural BMP effectiveness depends land conditions, including soil type, slope, and past management systems.
  - Cover Crops / Crop Rotation: 130 lbs N, 37 lbs P / 100 Ac / year (does not include credits from N-fixing cover crops)
  - Conservation Tillage: 260 lbs N, 39 lbs P / 100 Ac / year
  - Contour Farming: 120 lbs N, 41 lbs P / 100 Ac / year
  - Terraces and Diversions: 230 lbs N, 43 lbs P / 100 Ac / year
  - Vegetative Buffers: 334 lbs N, 54 lbs P / 100 Ac / year
  - Nutrient Management: 365 lbs N, 29 lbs P / 100 Ac / year
  - Split Nitrogen Applications: 28 lbs / 100 Ac / year
  - *Wetland Restoration:* 365 lbs N, 87 lbs P / 100 Ac / year

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**Precision Agriculture (Industry Studies, Ohio State University, Kansas State University, University of Iowa)**

- Variable Rate Applications: 28 lbs N, 2 lbs P / 100 Ac / year (reductions in overall fertilizer application not calculated)
  - AutoSwath: 15 lbs N, 2 lbs P / 100 Ac / year (reductions in overall fertilizer application not calculated)
  - *Irrigation*
    - *Improved Water Management:* 240 lbs N / 100 Ac / year
    - *Credits for Nitrates in Irrigation Water* (say 15ppm): 21 lbs / 100 Ac / year
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**Goal 3:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of nutrients entering the system.

**Objective 3.2:** Reduce / prevent nutrients from domestic animals and livestock from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 3.2.1 Implement structural BMPs (exclusionary fencing / watering facilities) in pastures with livestock access to surface waters.  Where applicable enroll sites into streambank/wetland restoration program.  <i>See Task 1.3.1</i>	Reduce break down of streambanks, disturbance of streambeds, and entrance of animal wastes in surface waters.	<i>See Task 1.3.1</i>	<i>See Task 1.3.1</i>	<i>See Task 1.3.1</i>	<i>See Task 1.3.1</i>
Task 3.2.2 Work with landowners to insure that surface water runoff from feedlots, drylots, or other pasture/holding facilities do not directly enter surface waters.  <i>See Task 1.3.2</i>	Reduced entry of surface soil and animal wastes into surface waters.  Improved forage quality.	<i>See Task 1.3.2</i>	<i>See Task 1.3.2</i>	<i>See Task 1.3.2</i>	<i>See Task 1.3.2</i>
Task 3.2.3 Work with farmers to implement manure management / application BMPs.  <i>See Task 1.3.3</i>	Reduced entry of animal wastes into surface waters.  Reduced P concentrations in areas of manure application.	<i>See Task 1.3.3</i>	<i>See Task 1.3.3</i>	<i>See Task 1.3.3</i>	<i>See Task 1.3.3</i>

**Load Reductions** (based upon Watershed Treatment Model, STEP-L and PRDICT models):

- *Exclusionary Fencing / Watering Facilities:* 380 lbs N, 40 lbs P / 100 Ac / year
- *Wetland Restoration:* 475 lbs N, 43 lbs P / 100 Ac / year
- *Feedlot Waste Storage / Management*  
If estimated waste exposed to run-off is cut in half, should see total reduction of 831 T N, 166 T P / year
- *Manure Management / Application BMPs*

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If estimated waste is applied in such a way as to prevent 85% of run-off from reaching surface waters, should see a total reduction of  
1,330 T N, 266 T P / year.

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**Goal 3:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of nutrients entering the system.

**Objective 3.3:** Reduce / prevent nutrients from parks and park-like areas from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 3.3.1 Work with DNR to promote available help for park and public area managers to eliminate/reduce wildlife (goose) waste runoff  <i>See Task 1.4.1</i>	Provide "how-to" documents & strategies in dealing with wildlife (goose) problems.  Reduce amount of animal (goose) waste entering surface waters.  Reduce impacts of wildlife (goose) population on park use and quality.	See Task 1.4.1  See Task 1.4.1  See Task 1.4.1	See Task 1.4.1  See Task 1.4.1  See Task 1.4.1	Number of buffer implementation plans.  (Social)  Buffer installations.  (Administrative)	Cost:  Implementation Plan: \$1500-2500  Buffers: 50¢ / LF (\$150/Ac Conservation Cover)  Sources: Parks, 319 funds, DNR, Conservation Organizations (QU, DU, DWF)
Task 3.3.3 Implement buffer strip BMPs on golf courses and parks & cemeteries to eliminate/reduce fertilizer runoff.	Reduced surface run-off  Reduced pollutants associated with surface run-off from entering streams.  Improved stream health.  Improved wildlife habitat.	SWCDs  DNR  Park Boards  Cemetery Boards  Park & Golf Course Managers	0-1 yrs: Work with park boards & managers to define buffer strip needs. Define implementation plan.  2-15 yrs: Install buffers	Achieve 30% of stream and lake bank buffer by year 10.  Achieve 60% of stream and lake banks buffered by yr 15.	Annual AI registration fee \$200 / yr (ea property)  Environmental Plan \$1500 – 2000  See Task 3.3.3  Buffers: 50¢ / LF (\$150/Ac Conservation Cover)  Sources: Parks, 319 funds, DNR, Conservation Organizations (QU, DU, DWF)
Task 3.3.4 Work with parks, golf courses, cemeteries and other park-like areas to obtain certification in Audubon International Cooperative Sanctuary Program.	Obtaining certification in Audubon Sanctuary program requires implementation of BMPs to reduce use and potential runoff of nutrients.  Improved marketing image of certified parks & park-like areas.  Potential for reduced insurance premiums.  Savings on chemical inputs.  Reduced exposure to chemicals.	Audubon International  Park Boards  Cemetery Boards  Park & Golf Course Managers	0-1 yrs: Enroll in program. Perform Site Assessment. Develop Environmental Plan.  1-5 yrs: Implement Environmental Plan.  Achieve first property certification by yr. 5.  Achieve 50% property certification by yr 15.	Number of properties enrolled in program and implementing Environmental Plans.  (Social)  Number of properties that have achieved program certification.  (Administrative)	Annual AI registration fee \$200 / yr (ea property)  Environmental Plan \$1500 – 2000  See Task 3.3.3  Buffers: 50¢ / LF (\$150/Ac Conservation Cover)  Sources: Parks, 319 funds, DNR, Conservation Organizations (QU, DU, DWF)

**Load Reductions** (based upon STEP-L, PReditCT model from the University of Pennsylvania and the Watershed Treatment Model from the Center for Watershed Protection):

- **Wildlife Management:** nominal reductions
- **Buffers:** 575 lbs N, 383 lbs P / 100 Ac / year  
Calculated at a 3:1 ratio of N to P and a rate of 4 lbs N / 1000 sf.

**Goal 3:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of nutrients entering the system.

**Objective 3.4:** Reduce / prevent nutrients from residential yards from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 3.4.1 Educate private landowners in methods of lawn/landscaping care that can reduce nutrient inputs.	Reduced nutrients from urban areas entering surface waters. Increased understanding of residential impacts on surface water quality.	Lawn and Garden Care Professionals. Garden Centers Garden Clubs 4-H Clubs	0-1 yr: Develop web page with downloadable fact sheets. 1-2 yrs: Write articles for media. Host workshop in conjunction with rain garden workshop.	Number of attendees at workshop. (Administrative) Requests for additional information. (Social)	Cost: <\$1000
Task 3.4.2 Educate private landowners in how buffers can eliminate / reduce nutrient runoff.	Reduced nutrients from urban areas entering surface waters. Increased understanding of residential impacts on surface water quality.	Lawn and Garden Care Professionals. Garden Centers Garden Clubs 4-H Clubs	0-1 yr: Develop web page with downloadable fact sheets. 1-2 yrs: Write articles for media. Host workshop in conjunction with rain garden workshop. Provide technical assistance in buffer design and installation.	Number of attendees at workshop. (Administrative) LF Urban Stream & Lake Buffers installed. (Administrative) Requests for additional information. (Social)	Cost: Workshop & Webpage: <\$1000 Buffers: 50¢ / LF (\$150/Ac Conservation Cover) Sources: 319 funds, DNR

**Load Reductions** (based upon STEP-L, PReditCT model from the University of Pennsylvania and the Watershed Treatment Model from the Center for Watershed Protection):

- **Buffers:** 575 lbs N, 383 lbs P / 100 Ac / year  
Calculated at a 3:1 ratio of N to P and a rate of 4 lbs N / 1000 sf.

**Goal 3:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of nutrients entering the system.

**Objective 3.5:** Reduce / prevent nutrients from failing septic systems from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 3.5.1 Develop septic system management and design ordinances for local soils conditions, including “alternative” approaches such as composting, incinerating, and wetlands systems.  <i>See Task 1.1.1</i>	For each County or Township adopting a septic system ordinance, water quality can be expected to maintain or improved through the change in practices outlined by the ordinance.	See Task 1.1.1	See Task 1.1.1	See Task 1.1.2	See Task 1.1.1
Task 3.5.2 Work with local health departments to insure effective inspection of septic system design and installation.  <i>See Task 1.1.2</i>	Water quality can be expected to maintain or improve through the change in design review and inspection practices	See Task 1.1.2	See Task 1.1.2	See Task 1.1.3	See Task 1.1.2
Task 3.5.3 Work with local banks to insure septic service records and system inspection is a requirement for any home loans.  <i>See Task 1.1.3</i>	Water quality can be expected to maintain or improve by requiring proper septic inspection to qualify for home loans.	See Task 1.1.3	See Task 1.1.3	See Task 1.1.4	See Task 1.1.3
Task 3.5.3 Education landowners with septic systems on their proper maintenance.  <i>See Task 1.1.4</i>	It can be expected that landowners who read the media articles will become more informed as to how their management practices can impact water quality. Some of these landowners can be expected to change their practices and this will improve or maintain water quality	See Task 1.1.4	See Task 1.1.4	See Task 1.1.4	See Task 1.1.4

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**Load Reductions** (based upon PRédict model from the University of Pennsylvania and the Watershed Treatment Model from the Center for Watershed Protection):

- *Failing Private Septic*  
A decrease from an estimated 75% failure rate to 50%, should result in total decreases of 13 TN, 5 TP / year.
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**Goal 3:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by reducing the amount of nutrients entering the system.

**Objective 3.6:** Reduce / prevent nutrients from CSOs from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 3.6.1 Work with businesses and landowners to insure that gutters are not connected to stormwater systems.  <a href="#">See Task 1.2.1</a>	CSOs are currently a substantial source urban based nutrient loads. Any and all reductions of stormwater flow through the sewer system will positively impact water quality	<a href="#">See Task 1.2.1</a>			
Task 3.6.2 Install public and private raingardens equal in volume to approximately 1% of roof and parking area runoff  <a href="#">See Task 1.2.2</a>	CSOs are currently a substantial source urban based nutrient loads. Any and all reductions of stormwater flow through the sewer system will positively impact water quality	<a href="#">See Task 1.2.2</a>			

**Load Reductions** (based upon the Watershed Treatment Model from the Center for Watershed Protection):

- **Combined Sewer Overflow**  
A nominal reduction of CSO-generated N and P loads can be expected by decreasing from an estimated 40% urban impervious areas to 35%.

**Goal 4:** To restore, conserve, and protect the hydrology of the watershed to improve water quality.

**Objective 4.1:** Perform flood plan management to prevent damaging effects of floods, preserve/enhance natural values, and provide optimal use of land and water resources within the floodplain.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 4.1.1 Reduce and delay runoff from roofs and paved areas through programs that promote installation of BMPs in urban areas.	Improved infiltration of precipitation. Reduced volume and velocity of stormwater runoff from urban areas. Reduced scouring and streambank erosion from volume & velocity of peak flows. Reduced surface run-off. Reduced sedimentation and turbidity resulting from stream bank erosion. Reduced pollutants associated with urban run-off entering streams. Improved stream health. Improved wildlife habitat	SWCDs NRCS Local Government Officials Conservation District Parks Departments Garden Clubs 4-H Clubs	See Task 1.2.2 See Task 2.2.4 In addition to the above: 0-1 yr: Obtain "buy in" from local governing bodies. 2-3 yrs: Work with partners to establish incentives to install BMPs, including structures such as grassed waterways around parking lots. Have at least 30% of new construction implementing recommended BMPs by year 10.	See Task 1.2.2 See Task 2.2.4 Number of commercial raingardens, grassed waterways and other stormwater detention and filtration projects. (Administrative)	See Task 1.2.2 See Task 2.2.4 Constructed Wetlands: \$3000-5000 / ac Grassed waterways: \$3000-\$5000 ac
Task 4.1.2 Work with County Officials to reduce development within the floodplain by implementing existing floodplain protection ordinance per FEMA / NFIP requirements.	Ability of property owners to insure against flood losses. Mitigation of potential flood loss through construction practice oversight and floodplain management as required by the program. Reduced chance of contaminants entering surface water through destruction of man-made structures during flood events.	Local Government Officials FEMA	0-1 yr: Obtain "buy in" from local governing body to enforce ordinance. 2-3 yrs: Provide training to building code officials.	Enforcement of ordinances. (Social) Number of design / location inspections. (Administrative)	Costs: increased building code enforcement.

**Load Reductions** (based upon STEP-I, PReditCT model from the University of Pennsylvania and the Watershed Treatment Model from the Center for Watershed Protection):

- *Bank Stabilization*
  - For moderately degraded streambank (4 ft deep, losing 0.06-0.2 feet / year): 73 T / mile streambank / year
- *Wetland Restoration*
  - Wetland effectiveness depends upon drainage area land uses, conditions, and wetland design. The following figures do not take into account reduction of downstream stream bank erosion.
    - Urban: 7.2 T / 100 Ac / year
    - Detention Basin
  - Wetland effectiveness depends upon drainage area land uses, conditions, and wetland design. The following figures do not take into account reduction of downstream stream bank erosion.
    - Urban: 7.4 T / 100 Ac / year
- *Rain Gardens*
  - Effectiveness of rain gardens have minimal direct impacts on sedimentation. Their primary effect on erosion is the slowing of water to prevent channel and streambank erosion. A decrease in imperviousness from 40% to 35% in urban areas should yield a 46 T / year reduction in sediments.

**Goal 4:** To restore, conserve, and protect the hydrology of the watershed to improve water quality.

**Objective 4.2:** Limit net increase of impervious surfaces in order to limit runoff associated with development.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 4.2.1 <i>See Task 2.2.4</i>	Reduced scouring and streambank erosion from volume & velocity of peak flows.  Reduced sedimentation and turbidity resulting from stream bank erosion.  Reduced surface run-off.  Reduced pollutants associated with urban run-off entering streams.  Improved stream health.  Improved wildlife habitat	See Task 2.2.4	See Task 2.2.4	See Task 2.2.4	See Task 2.2.4

**Load Reductions** (based upon STEP-I, PReditCT model from the University of Pennsylvania and the Watershed Treatment Model from the Center for Watershed Protection):

- *Detention Basin*  
Wetland effectiveness depends upon drainage area land uses, conditions, and wetland design. The following figures do not take into account reduction of downstream stream bank erosion.
  - Urban: 7.4 T / 100 Ac / year
- *Rain Gardens*  
Effectiveness of rain gardens have minimal direct impacts on sedimentation. Their primary effect on erosion is the slowing of water to prevent channel and streambank erosion. A decrease in imperviousness from 40% to 35% in urban areas should yield a 46 T / year reduction in sediments.

**Goal 4:** To restore, conserve, and protect the hydrology of the watershed to improve water quality.

**Objective 4.3:** Restore and protect the full surface water network, including headwaters, ephemeral streams, and wetlands to positively impact water temperature, add storage capacity, and reduce velocity following rain events.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 4.3.1 Work with landowners to restore streams to a more naturally vegetated and meandering state and conserve high quality stream habitat.	See Tasks 1.3.1, 2.1.1, 2.2.2 Overall improved riparian health, water quality, wildlife habitat, and water storage capacities.	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2
Task 4.3.2 Work with landowners to restore and conserve wetlands and vernal pools.	See Tasks 1.3.1, 2.1.1, 2.2.2 Overall improved riparian health, water quality, wildlife habitat, and water storage capacities. Improved habitat for marginal species.	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2
Task 4.3.4 Work with landowners to restore ephemeral streams and headwaters.	See Tasks 1.3.1, 2.1.1, 2.2.1 Overall improved riparian health, water quality, wildlife habitat, and water storage capacities. Improved habitat for marginal species.	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2	See Tasks 1.3.1, 2.1.2
Task 4.3.5 Develop and implement a Mitigation Clearinghouse to connect landowners with potential stream, wetland, ephemeral stream or headwater sites to those in need of mitigation projects.	Increased likelihood of practice implementation. Improved practice financing strategies. Improved habitat for marginal species.	IDEM / INDOT / DNR Mitigation Partners SWCDS Conservancy Districts Drainage Boards	0-1 yr: Design database structure. Hold public meeting. Enroll potential sites into program. Elicit potential mitigation partner support. 2-15 yrs: Continue marketing and enrollment into program. Track active project / project costs.	Number of projects. (Administrative) LF of stream restoration. (Administrative) Acres of wetland restoration. (Administrative) Number of ephemeral streams and headwaters restored. (Administrative)	\$5,000 / year

Task 4.3.6 Increase landowner participation in programs such as the Wetland Reserve Program through strategic marketing.	The number of landowners and/or acreage enrolled in conservation programs is directly related to reductions of surface water volume, surface water velocity, and surface water quality.	SWCDs NRCS	0-3 yrs: Work with agronomists and ag suppliers to strategically market program to producers. Take applications from at least 1 new producer / year into program.  3-15 yrs: Continue marketing and conservation plan development.	Documented number of growers enrolled in programs (Social)	Costs: \$5,000 / yr
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**Load Reductions:**

Load reductions are dependent upon land uses and conditions. Any and all BMPs listed in Goals 1-3 can be applied as a base guide.

It is known that implementation of multiple BMPs usually has a synergistic impact, so that the value of the whole is greater than the sums of individual practices.

**Goal 5:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by preventing or reducing the amounts of metals and sulfates entering the surface waters.

**Objective 5.1:** Reduce / prevent metals and sulfates resulting from acid mine discharge from entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 5.1.1 Identify and catalog abandoned mine land sites.	Geo-referenced information can improve efficiency of multiple small site AML reclamation projects.	DNR – DOR Sycamore Trails RC&D SWCDs	0-2 yrs: Launch awareness campaign. Work with Sycamore Trails to educate public on AML identification.  2-4 yrs: Develop and market AML Clearinghouse.  2-15 yrs: Ground-truth and inventory land-owner / citizen submitted AML sites.	Number of sites identified and entered into AML Clearinghouse. (Administrative)	\$5,000 / year  Number of restoration projects completed. (Administrative)
Task 5.1.2 Work with Sycamore Trails RC&D, Indiana DNR – Division of Reclamation, and Office of Surface Mining to restore abandoned mine land sites and prevent pollutants associated with those sites from entering surface waters.	Reduction of AML-related pollutants entering surface waters.  Improved ecosystem health.	DNR – DOR Sycamore Trails RC&D SWCDs	0-2 yrs: Launch awareness campaign. Work with Sycamore Trails to educate public on AML identification.  2-15 yrs: Use AML Clearinghouse to identify and prioritize sites.	Number of restoration projects completed. (Administrative)  Water sampling (turbidity, pH, TDS, sulfates, metals) (Environmental)	Costs: Project Dependent  Sources: IDNR, Sycamore Trails RC&D

**Load Reductions:**  
Load reductions are project and source dependent.

**Goal 5:** To improve and protect the fishery and other indigenous aquatic life and wildlife of the watershed by preventing or reducing the amounts of metals and sulfates entering the surface waters.

**Objective 5.2:** Reduce the amount of urban-based pollutants entering surface water.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 5.2.1 Develop and implement household waste education programs.	Each resident properly disposing of potentially hazardous materials will result in maintained and improved water quality.	Solid Waste Districts Indiana Household Waste Management Task Force Sycamore Trails RC&D	0-2 yrs: Launch awareness campaign.  Work with Sycamore Trails & use existing documentation to educate public on proper disposal of household waste.	Web page. (Administrative)  Requests for materials. (Social)	Costs: <1000  Source: 319 Funds, Sycamore Trails
Task 5.2.2 Promote efforts for annual collection days of Household Hazardous Waste to prevent them from entering the surface waters.	Each resident properly disposing of potentially hazardous materials will result in maintained and improved water quality.	Solid Waste Districts Indiana Household Waste Management Task Force Sycamore Trails RC&D	0-2 yrs: Plan collection, locate hazardous waste disposal firm, set date.  2-3 yrs: Launch publicity campaign.  Host collection day.  Determine appropriate timeframe for additional collection days.  3-15 yrs: Host collection days.	Amount of waste collected. Number of collection day participants. (Administrative)	Costs:  Organization: \$1000 – 2000 Collection and Disposal: TBD  Sources: Private grants, Indiana Household Waste Grant Program (temporarily suspended)
Task 5.2.3 Reduce and delay runoff from roofs and paved surfaces through programs that promote installation of BMPs in urban areas.	See Tasks 2.2.4, 4.2.1	See Tasks 2.2.4, 4.2.1	See Tasks 2.2.4, 4.2.1	See Tasks 2.2.4, 4.2.1	See Tasks 2.2.4, 4.2.1

**Load Reductions:**

Household hazardous waste pollutant sampling has not been conducted. Existing loads from household hazardous wastes have not been determined.

**Goal 6:** To improve and protect the fishery and other indigenous aquatic life and wildlife in the watershed by preventing or reducing the amount of pesticides entering the surface water.

**Objective 6.1:** Reduce / eliminate pesticides used in residential applications from reaching surface waters.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 6.1.1 Continue and promote efforts for annual collection days of Household Hazardous Waste to prevent them from entering the surface waters  <a href="#">See Task 5.2.2</a>	<a href="#">See Task 5.2.2</a>	<a href="#">See Task 5.2.2</a>	<a href="#">See Task 5.2.2</a>	<a href="#">See Task 5.2.2</a>	<a href="#">See Task 5.2.2</a>
Task 6.1.2 Develop educational materials on integrated pest management and safe use of pesticides.  <a href="#">See Task 5.2.2</a>	It can be expected that landowners who read the media articles will become more informed as to how their use of pesticides can impact water quality. Some of these landowners can be expected to change their practices and this will improve or maintain water quality	SWCDS Extension Service Garden Clubs Garden Centers	0-1 yrs: Develop web page with downloadable factsheets.  1-2 yrs: Write articles for media.  Year 2: Incorporate integrated pest management concepts into rain garden workshop.	Requests for information. (Social)  Number of attendees at workshop (Administrative)	Cost: <\$1,000

**Load Reductions:**

Pesticide pollutant sampling has not been conducted. Existing loads from pesticides have not been determined.

**Goal 6:** To improve and protect the fishery and other indigenous aquatic life and wildlife in the watershed by preventing or reducing the amount of pesticides entering the surface water.

**Objective 6.2:** Reduce / eliminate pesticides used in parks and park-like applications from reaching surface waters.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 6.2.1 Work with park, cemetery, and golf course managers to implement integrated pest management systems.	IPM can reduce use and potential runoff of chemicals. Reduced costs related to chemical usage.	SWCDs NRCS DNR Extension Service Park Boards Cemetery Boards Park & Golf Course Managers	0-1 yrs: Develop web page with downloadable factsheets.  1-2 yrs: Meet with park, cemetery & golf course managers to provide assistance in IPM implementation.  Year 2: Follow-up with park, cemeteries, & golf courses on IPM implementation  Yrs 5, 10, 15: (Or as needed) Review current IPM standards, provide updated information to park, cemeteries, & golf courses.	Number of properties implementing IPM practices. (Administrative)	Webpage, factsheets: <1,000  Meetings & Workshops: \$1000 / year
Task 6.2.2 Implement buffer strip BMPs on golf courses and parks to reduce pesticide runoff.  See Task 3.3.3	See Task 3.3.3	See Task 3.3.3	See Task 3.3.3	See Task 3.3.3	Annual AI registration fee \$200 / yr (ea property) Environmental Plan \$1500 – 2000 See Task 3.3.3 Buffers: 50¢ / LF (\$150/Ac Conservation Cover)  Sources: Parks, 319 funds, DNR, Conservation Organizations (QU, DU, DWF)

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chemicals.

**Load Reductions:**

Pesticide pollutant sampling has not been conducted. Existing loads from pesticides have not been determined.

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**Goal 6:** To improve and protect the fishery and other indigenous aquatic life and wildlife in the watershed by preventing or reducing the amount of pesticides entering the surface water.

**Objective 6.3:** Reduce / eliminate pesticides used in agricultural operations from entering surface waters.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 6.3.1 Work with agronomists and farmers to adopt integrated pest management systems.	IPM can reduce use and potential runoff of chemicals. Reduced costs related to chemical inputs.	SWCDs NRCS DNR Extension Service Agronomists Ag Suppliers	0-3 yrs: Strategically market program to producers. Enroll at least 3 new producers / year into NRCS or BCWP programs. Provide presentation on IPM at Pesticide Applicator Recertification Program (PARP) accredited workshop.	Number of properties implementing IPM practices. ( <i>Administrative</i> )	Costs: Scouting: \$20 / Ac Workshop presentations: <\$1000
Task 6.3.2 Work with farmers and commercial applicators to adopt precision agriculture technology to reduce excess applications of pesticides.  See Task 3.1.3	Lightbars or autosteer technology can reduce application overlap by 5%. Autostealth technology can reduce application overlap by 10-15% - potentially more in odd-shaped fields.  Reduced input costs. Reduced field time.	SWCDs NRCS Agronomists Ag Suppliers	By year 15, 50% of all growers implementing some type of IPM program.	See Task 3.1.3	See Task 3.1.3

**Load Reductions:**

Pesticide pollutant sampling has not been conducted. Existing loads from pesticides have not been determined.

Use of Precision Ag technology can reduce pesticide overlap by an average of 10% - *without PA*, 1 out of 10 acres will be sprayed twice. (Based upon industry studies, and information from Ohio State University, Kansas State University and Iowa State University.)

**Goal 7:** Restore, conserve, and protect the surface water network to improve overall stream health, hydrology, and wildlife habitat

**Objective 7.1:** Conserve and restore all orders of streams within the watershed to improve overall health of the biosystem

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 7.1.1 Implement BMPs to protect lower order (headwater) streams and seasonal wetlands.	Increased precipitation infiltration. Decreased turbidity, sedimentation.	SWCDs NRCS Conservancy District Drainage Boards. Mitigation Partners	0-3 yrs: Develop site-specific conservation plans. Enroll sites into mitigation clearinghouse.  2-15 yrs: Develop engineering plans and secure permits as required.  4-15 yrs: Intermittent stream preservation / restoration activities.	LF of intermittent streams restored. (Administrative)	Costs: Mitigation Clearinghouse: \$5,000 / yr Engineering / Permitting: \$500 ea (100 ft) Restoration: \$2500 - \$5000 / site (100 ft)
Where applicable, enroll sites into wetland restoration programs.	Decreased nutrient and pesticide runoff Improved biotic community.				Sources: 319 funds, NRCS Programs, DNR Programs, Government Agencies & Private Parties in need of mitigation.
Task 7.1.2 Work with landowners to restore streams to a more naturally vegetated and meandering state and conserve high quality stream habitat	See Tasks 2.1.1, 2.2.1		See Tasks 2.1.1, 2.2.1	See Tasks 2.1.1, 2.2.1	See Tasks 2.1.1, 2.2.1
Task 7.1.3 Develop and implement a Mitigation Clearinghouse to connect landowners with potential stream, wetland, ephemeral stream and headwater sites to those in need of mitigation projects.	Leveraging of grant funds. Improved financial viability of restoration for private individuals. Improved overall health of riparian community	SWCDs Conservancy District Drainage Boards Landowner Associations	0-1 yr: Develop web site, registration guidelines, and database of enrolled properties. Develop core group of mitigation partners. Enroll potential sites into statewide database  By year 5, matched at least 1 mile of streams and 25 Ac of wetlands with mitigation pts.  By year 10, matched at least 5 miles of streams and 75 acres of wetlands with mitigation partners.	LF of streams / Ac of wetlands enrolled in Mitigation Clearinghouse (Administrative)  LF of streams / Ac of wetlands matched to mitigation partners (Administrative)	Cost: \$5,000 / years  Sources: 319 funds, Clean Water Indiana

**Load Reductions:**

Load reductions are dependent upon land uses and conditions. Any and all BMPs listed in Goals 1-3 can be applied as a base guide.

It is known that implementation of multiple BMPs usually has a synergistic impact, so that the value of the whole is greater than the sums of individual practices.

<b>Goal 7:</b> Restore, conserve, and protect the surface water network to improve overall stream health, hydrology, and wildlife habitat
<b>Objective 7.2:</b> Incorporate Green Infrastructure planning techniques throughout the watershed to reduce habitat isolation and improve overall health of the biosystem.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 7.2.1 Develop and implement conservation plans that incorporate connectivity between various headwaters, streams, and wetlands.  Where applicable, enroll sites into wetland/stream restoration programs.	Synergistic relationships between various systems can magnify water and environmental quality improvement.  Connectivity between systems provides essential corridors for wildlife, especially reptiles and amphibians.	SWCDs NRCS DNR  Conservancy District Conservation Groups  Regulatory Agencies  Mitigation Partners	0-15 yrs: Strategically market program to producers and landowners in conjunction with other BMPs / Conservation Plan development.  By year 5, 5% of all projects incorporate connectivity.  By year 10, 10% of all projects incorporate connectivity  By year 15, 20% of all projects incorporate connectivity.	LF of interconnected streams. (Administrative)  Number of projects incorporating connectivity (Administrative)	Costs: Mitigation Clearinghouse: \$5,000 / year  Conservation Plans: \$500 - \$1,000 each  Green Infrastructure / Development Plan: \$5000 - \$10,000  Sources: 319 funds, DNR programs, Conservation Groups (QU, DU, Audubon, etc)
Task 7.2.2 Develop and implement large scale conservation planning that provides connectivity between managed lands.	Synergistic relationships between various systems can magnify water and environmental quality improvement.  Connectivity between systems provides essential corridors for wildlife, especially reptiles and amphibians.  Corridors can provide means of wildlife travel, reducing isolation and improving genetic diversity.	SWCDs NRCS DNR FWS  Conservancy District Conservation Groups	0-3 yrs: Develop conceptual land use / land planning targets.  3-5 yrs: Prioritize areas for restoration and/or conservation.  3-15 yrs: Target landowners for conservation / restoration programs.	Land-use / Land Planning documents. (Administrative)  Ranked target areas. (Administrative)  LF / Acres of connected corridors. (Administrative)	Costs: Mitigation Clearinghouse: \$5,000 / year  Conservation Plans: \$500 - \$1,000 each  Green Infrastructure / Development Plan: \$5000 - \$10,000  Sources: 319 funds, DNR programs, Conservation Groups (QU, DU, Audubon, etc)

#### Load Reductions:

Load reductions are dependent upon land uses and conditions. Any and all BMPs listed in Goals 1-3 can be applied as a base guide.

It is known that implementation of multiple BMPs usually has a synergistic impact, so that the value of the whole is greater than the sums of individual practices.

**Goal 8:** Improve and protect the warmwater fishery and other indigenous aquatic life and wildlife by eliminating improper disposal of solid waste.

**Objective 8.1:** Establish education, outreach, and clean-up programs to reduce in-stream and roadside dumping.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 8.1.1 Develop an outreach and education program to "raise a generation" of non-litterers.	Schoolchildren who are well-educated on the impacts of littering and dumping are less likely to litter / dump as adults.  Children of non-litterers / dumpers are far less likely to litter or dump as adults.	School Districts 4-H Clubs Church Organizations  Media Local Businesses  Keep America Beautiful	0-2 yrs: Development of webpage, downloadable materials. Become KAB Affiliate.  2-5 yrs: Organize "clean-up" days based on Adopt a River / Adopt a Highway campaigns.  Work with media to deploy PSAs.  Post Flyers / Posters at local businesses	Number of "Clean-up" groups. (Social)  Number of PSAs (Social)  Number of participating businesses (Social)	Costs Webpage: <\$1000  Clean-up Supplies (trash bags, gloves, safety vests, etc) \$1500 / yr  Printing / Design: \$500 / yr  Sources: Private Funds, INDOT (Hwys), KAB, Other Grant sources
Task 8.1.2 Develop an hunter education and outreach about proper disposal of animal carcasses.	Reduction of in-stream carcasses should result in reduction of potential health-hazardous bacteria in surface waters.	DNR Hunters Check Stations  Hunting Supply Shops	0-2 yrs: Development of webpage, downloadable materials.  Provide flyers to shops, check stations, DNR	Reduction of dumped carcasses or offal. (Administrative)  2-15 yrs: Review impact, revise flyers / campaign.	Costs: Webpage: <\$1000  Printing / Design: \$500 / yr  Sources: DNR, Private Sources

**Load Reductions:**

Levels of pollutants directly related to dumping / littering is unknown, however, no levels of hazardous materials sources have been identified for the BCW and include: car batteries, alkaline batteries, computer components, refrigerators, freezers, chemical containers, and meth lab remnants.

Loads of carcass and offal-related pollutants (bacteria) has not been determined.

**Goal 8: Improve and protect the warmwater fishery and other indigenous aquatic life and wildlife by eliminating improper disposal of solid waste.**

**Objective 8.1: Establish education, outreach, and clean-up programs to reduce in-stream and roadside dumping.**

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 8.2.1 Work with local officials to impose harsh fines for littering / dumping. (Up to \$1000 by Indiana law)	Enforcement of anti-litter / dumping laws have been shown to be far more effective than education campaigns in litter/dumping reduction.	City / County Law Enforcement  DNR Conservation Officers  Judicial Officials (Prosecutor, Judges)  Incarceration Officials (Probation Officers, Jail Officials)	0-2 yrs: Work with local officials to develop scale of fines. (IA fines \$5000 for dumping of materials over 5 lbs), Work with local prosecutors / judges to insure penalties will be imposed.  Launch awareness campaign.  2-5 yrs: Work with law officials to effectively enforce laws without hindering other services.	Number of tickets issued. (Administrative)  Reduction in volume of dumping. (Administrative)	Costs: \$2,500 - \$5,000 / yr  Sources: Fines  Non-tangible improvement of community perception by companies or those seeking to relocate.
Task 8.2.2 Work with law enforcement and judicial officials to implement in-stream and road-side clean up as part of community service for offenders.	Once a site has been cleaned up, it tends to stay cleaned up. Community Service can be a more economical option to criminal justice than jail time.	City / County Law Enforcement  DNR Conservation Officers  Judicial Officials (Prosecutor, Judges)  Incarceration Officials (Probation Officers, Jail Officials)	0-2 yrs: Work with law officials to effectively enforce laws without hindering other services.  Work with local prosecutors / judges to implement community service in lieu of incarceration.  2 – 15 yrs: Review and adapt enforcement plans	Number of violators prosecuted. (Administrative)  Reduction in volume of dumping. (Administrative)	Costs: Supplies: trash bags, gloves, safety vests, etc): \$1500 / yr  Staff: \$5,000 - \$10,000 / yr  Sources: Savings over incarceration costs.
Task 8.2.3 Sponsor amnesty days for tires, electronics, and appliances.	Providing centralized, inexpensive or no-cost options for disposal of potential hazardous chemicals and/or components can reduce potential in-stream loading.	Solid Waste Districts  County Health Departments  Local and Regional Businesses	0-2 yrs: Identify potential partners. Plan amnesty day events.  2-5 yrs: Implement Amnesty Days (Electronics, Appliance, Tire – 1 ea / quarter)  4-15 yrs: Review and adapt amnesty day requirements	Number of participants. (Administrative)  Volume of collected materials (Administrative)	Costs: \$8,000 - \$10,000 / yr  Sources: IDEM Electronic Waste Program, IDEM Waste Tire Fund (temporarily suspended), IDEM Recycling Promotion Assistance Fund (temporarily suspended), Businesses (who already

		collect items)	Savings from reduction of dump sites.
Task 8.2.4 Work with city/township officials to provide trash pick-up as part of utility services.	Reduction of roadside / in-stream trash, especially on roads commonly used as dumps. (Typically within 2 miles of the town)  Possible semi-annual pickup of large items (sofas, furniture).	City Officials Solid Waste Districts  Refuse Removal Companies	0-3 yrs: Work with City Officials to plan / launch trash pick-up services. Launch awareness campaign.  3-5 yrs: Trash pick-up for all incorporated communities 5-7 yrs: Trash pick-up for all communities.  7-10 yrs: Investigate potential rural trash pickup.
Task 8.2.5 Develop and implement program to provide alternative trash disposal options to area residents.	Reduction of roadside / in-stream trash, especially on roads commonly used as dumps. (Typically within 2 miles of the town)	Solid Waste Districts  Business / Corporate Sponsor	0-5 yrs: Work with local Business / Industry to implement pilot "self-serve" dumpster program.  5-10 yrs: Review / adapt appropriate deployment of additional dumpsters.

### **Load Reductions:**

Levels of pollutants directly related to dumping / littering is unknown, however, no levels of hazardous materials sources have been identified for the BCW and include: car batteries, alkaline batteries, computer components, refrigerators, freezers, chemical containers, and meth lab remnants.

**Goal 9:** Prevent the introduction and spread of invasive species through management practices

**Objective 9.1:** Establish invasive species control programs to prevent spread of exotics

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 9.1.1 Develop education materials on the identification and eradication of invasive species.	Reduction of invasive species can provide:  Improved wildlife habitat.  Improved preservation of sensitive biosystems	SWCDS  Sycamore Trails RC&D  Central Indiana Weed Management Association.	0-1 yrs: Compile existing documentation. Develop web page with downloadable fact sheets.  1-3 yrs: Write articles for media. Participate in workshops and other events with existing weed management groups.	Monitor spread of invasive species. (Environmental)	Costs: Web page, flyers, factsheets: \$1,000  Workshops: \$500
Task 9.1.2 Incorporate invasive species control practices in other workshops – such as forestry and rain garden workshops.	Reduction of invasive species can provide:  Improved wildlife habitat.  Improved preservation of sensitive biosystems	SWCDS  Sycamore Trails RC&D  Central Indiana Weed Management Association.	0-1 yrs: Develop presentation materials, flyers, handouts.  1-3 yrs: Present information on invasive species at other workshops.	Requests for additional information (Social)  Number of workshop attendees. (Administrative)	Costs: Web page, flyers, factsheets: \$1,000  Workshops: \$500

**Load Reductions:**

Levels of pollutant load reduction will be related to preservation of sensitive biosystems, including riparian areas and wetlands.

**Goal 10:** Further refine critical areas to effectively implement practices to improve water quality.

**Objective 10.1:** Improve effectiveness of BMP deployment by defining probable sources within current critical areas.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 10.1.1 Pre-filter probable sources of pollutants through analysis of georeferenced data.	Provides probable targets for BMP marketing.	USGS IGS Indiana Water Resources Assn. ISU Vincennes University Consultants	Ongoing: geostatistical analysis to narrow critical areas within 14-digit watersheds	Correlation of analysis with real-world data (Administrative)	Cost: Additional Sampling: \$30,000 - \$40,000 / year (\$100 ea sample, no metals) Analysis: \$10,000 / year Sources: 319 funds, DNR programs, ESRI
Task 10.1.2 Ground-truth and inventory pollutant sources of pre-filtered drainage areas.	Provides verifiable documentation of pollutant sources.	USGS IGS Indiana Water Resources Assn. ISU Vincennes University Consultants	Ongoing: Visual assessment and of identified stream reaches (from Task 10.1.1). Locate potential sampling points.	Correlation of analysis with real-world data (Administrative) Database of probable pollutant sources. (Administrative)	See Task 10.1.1
<i>To be performed with Task 10.1.1</i>					
Task 10.1.3 Develop and implement sampling modeling strategies to identify sources of pollutants within drainage areas.	Provides improved methodology to document pollutant sources.	USGS IGS Indiana Water Resources Assn. ISU Vincennes University Consultants	Ongoing: Sampling and modeling of identified and confirmed stream reaches. Geostatistical analysis of results.	Correlation of analysis with real-world data. (Administrative) Database of verified pollutant sources. (Administrative) Identification of critical stream reaches (Administrative)	See Task 10.1.1
					Quality Assurance / Quality Control Guidelines that work. (Administrative)

#### Load Reductions:

Indirect – through more efficient targeting of BMP implementation sites and types.

**Goal 10:** Further refine critical areas to effectively implement practices to improve water quality.

**Objective 10.2:** Prioritize critical sub-areas for sources of loading and probable/practical implementation of BMPs.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 10.2.1 Analyze and model data to calculate pollutant loads and sources within critical sub-areas.	Provides improved methodology to document pollutant sources. More effective prioritization of BMP implementation and landowner participation.	USGS IGS Indiana Water Resources Assn. ISU Vincennes University Consultants	Ongoing: Sampling and modeling of identified and confirmed stream reaches. Geostatistical analysis of results.	Correlation of analysis with real-world data. (Administrative)	See Task 10.1.1
Task 10.2.2 Catalog and classify probability of landowner participation and current BMP effectiveness.	More effective prioritization of BMP implementation and landowner participation.	USGS IGS Indiana Water Resources Assn. ISU Vincennes University Consultants	Ongoing: review of landowners in target areas to “cherry pick” BMP implementation	Prioritized database of landowners / BMPs (Administrative)	See Task 10.1.1

#### Load Reductions:

Indirect – through more efficient targeting of BMP implementation sites and types.

**Goal 11:** Build capacities of the BCWP to effectively attain the goals listed above.

**Objective 11.1:** Develop appropriate planning to insure the long-term viability and effectiveness of the BCWP.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 11.1.1 Develop a Plan of Work to outline staffing, equipment, financial and other needs required to further the goals and mission of the BCWP.	Planned and documented capacity building strategies provide guidelines for the group as a whole and for new partnership staff and volunteers.	SWCDS Sycamore Trails RC&D Partnership for Turtle Creek	0-1 yr: Outline and main draft complete. 1-2 yrs: Completion of plan of work. 2-15 yrs: Annual review and update of plan of work.	Completion of Plan of Work (Administrative)	Costs: Plan: \$5,000 Review / Update: \$2,500 / yr  Sources: 319 Funds, Partnership for Turtle Creek
Task 11.1.2 Develop a financial plan and implement funding strategies to insure the viability of the BCWP.	Outline of necessary funding provides basic budgetary guidance. A Financial Plan can serve as a prospectus for potential granting agencies.	SWCDS Sycamore Trails RC&D Partnership for Turtle Creek	0-1 yr: Outline and main draft complete. 1-2 yrs: Completion of Financial Plan 2-15 yrs: Annual review and update of Financial Plan.	Completion of Financial Plan (Administrative)	Costs: Plan: \$5,000 Review / Update: \$2,500 / yr  Sources: 319 Funds, Partnership for Turtle Creek

#### **Load Reductions:**

Indirect – through more efficient deployment of programs, use of funds, and development of funding sources.

**Goal 11:** Build capacities of the BCWP to effectively attain the goals listed above.

**Objective 11.2:** Develop appropriate planning to insure the long-term viability and effectiveness of the BCWP.

Task	Benefits	Key Parties	Timeline	Success / Performance Measure	Cost and Funding Sources
Task 11.2.1 Scout for and hire appropriate staff in a timely manner.	Efficient use of time and funds by targeting / pre-screening potential staff.	SWCDs NRCS IWRA Conservation Groups Conservation Professionals	0 – 1 yr: Develop 5-yr staffing needs. Match with potentially available candidates.  1 – 15 yrs: Annual review of 5-yr staffing needs. Timely hiring of staff.	Pool of appropriate, pre-scouted candidates. (Administrative)	Cost: \$500 - \$1000 / yr  Sources: SWCDs, Watershed Partnerships
Task 11.2.2 Develop and maintain a catalog of volunteer's skills, interests, and availability.	Improved relationships with volunteers.  Increased volunteer list.  Improved efficiency of "on-the-ground" project implementation.	SWCDs Sycamore Trails RC&D	0-1 yr: Acquire Volunteer Management Software. Develop database  1-2 yrs: Volunteer / staff in place to maintain database	Working, filterable database in place (Administrative)	Cost: Software: 0 - \$1000  Database development: \$2,000 - \$5,000  Database maintenance: \$2,500 - \$5,000 / year  Source: In-kind, SWCD, RC&Ds
Task 11.2.3 Continue to establish and maintain partnerships with other organizations to further their goals and the goals of the BCWP	Maintain and improve relationships with project partners and organizations.  Improved funding potential.	SWCDs IASWCD IDEM IWRA National Assn of Conservation Districts Sycamore Trails RC&D Key Mitigation Partners	0-2 years: Develop "prospectus" to provide potential partners. Develop template for marketing materials  Ongoing: Review / update marketing materials on annual basis. 3-5 new partners each year.	List of partnership. (Administrative)  "Prospectus" = Financial Plan (Task 11.1.2)	Cost: Marketing materials: \$1500 - \$1500 / year  Source: In-kind, Watershed Partnerships, Private Sponsors.
Task 11.2.4 Maintain the BCWP Technical and Planning Committee to provide input and direction of both work and growth.	Maintain and improve community input, dialogue, and buy-in.	SWCDs Conservancy District Government Officials Successful Watershed Groups	Annual: Review of committee members, enlistment of new members. Review / Revise how committees work.	Active Technicians and Planning Committees (Social)	Cost: \$1,000 - \$1,500 / yr  Source: 319 Funds, Watershed Partnerships

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**Load Reductions:**

Indirect – through more efficient deployment of programs, use of funds, and development of funding sources to insure long-term sustainability.

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